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THE DESCENDANTS OF PALÆOLITHIC MAN IN AMERICA.

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THE modest, peaceful valley of the Delaware River, from the head of tide-water southward, is as little suggestive of the Arctic Circle, for at least nine months of the year, as do its low and weedy banks in summer suggest the tropics. On the contrary, every tree, shrub, sedge, beast, bird, or fish that you see above, about, or within it is a feature of a strictly temperate climate. Nevertheless, a dim recollection of more stirring times still clings to it, and the year not unfrequently opens with the river firmly ice-bound. Over its shallows are often piled great masses of up-river ice, borne hither after a storm by the swollen current. Often the broad and shallow channel is effectually closed, and the river becomes, for the time being, a frozen lake.

But the ice, of late centuries, has not been able to hold its own for any significant length of time. The increasing warmth of the sun, and the south winds with their accompanying rains, soon start the little icebergs oceanward, or melt them when they are securely stranded. Except a few scattered masses along the shady shores, the river, by April, is a quiet, shallow, tide-water stream again.

No appreciable amount of detritus is now brought from the up-river region by a single winter's accumulation of ice. As the river and its shores are to-day, so they were a century ago—perhaps for many; but the winter of our varying year is a mere puppet-show compared with what New Jersey winters once were, and the culmination of arctic rigors gave our Delaware Valley, in that distant day, a far different aspect; and, with each suc-

ceeding glacial flood, more and more sand, gravel, and great bowlders were rolled down from the rock-ribbed valley beyond and spread upon the open plain through which the present stream unruffled flows.

The land was somewhat depressed then, and the water flowed at a higher level, but nothing unfavorable to man's existence obtained in the whole region. As a skilled geologist has pointed out, "The northern ice was one hundred miles away, and did not prevent primitive man from assembling about the low and hospitable shores of the miniature sea, . . . and over the bosom of the bay, little affected by tide because of its distance from the ocean, and little disturbed by waves because of its shoalness, palæolithic man may have floated on the simplest craft, or even have waded in the shallow waters." Ay! may have; but did he? What evidence is there that that most primitive of mankind, who left such abundant traces of his presence in the valley of many a European river, and also in Asia and Africa, was ever likewise here in eastern North America? It is precisely the same evidence—rude stone implements of the simplest type, often but slightly modified cobbles merely, that were found to be more effective by having a chipped and jagged edge, rather than the smooth and tapering one that water-wearing produces. These same worked stones—in other countries always of flint, but in New Jersey of argillite, a slate-like stone that has been altered by heat, and possesses now a conchoidal fracture—these occur in the Delaware gravels; and the vivid pictures of glacial time, with primitive man a prominent feature thereof, that have been given by Wright, Wilson, Haynes, McGee, Upham, Cresson, Babbitt, and others, are doubtless familiar to all readers of recent scientific literature.

In associating man with ancient river valleys, we are too apt to think only of the stream, and ignore the surrounding country. Though largely so, palæolithic man was not strictly an amphibious creature; for instance, on each side of the ancient Delaware River extended wide reaches of upland forest, and here, too, the rude hunter of the time found game well worthy of his ingenuity to capture, and so powerful that all his wit stood him well in need to escape their equally determined efforts to capture him. While the seal and walrus disported in the river; while fish in countless thousands stemmed its floods; while geese and ducks in myriads rested upon the stream, so, too, in the forest roamed the moose, the elk, the reindeer, the bison, the extinct great beaver, and the mastodon, all of which, save the elk, had long since left for more northern climes when European man first sighted North America.

The association of man and the mastodon is somewhat start-

ling to most people; but, as has been time and again conclusively shown, it is no unwarranted fancy. We are apt to consider the mastodon as a creature of so distant a time in the unrecorded past, that man must necessarily have appeared much later upon the scene. The truth is, comparatively speaking, the creature so recently became extinct that, in all probability, our historic Indians were acquainted with it. Certain it is that, in the distant long ago of the great Ice age, the mastodon existed, and equally certain that with him lived that primitive man who fabricated the rude implements we have described. The bones of the animal and the bones and weapons of the man lie side by side, deep down in the gravels deposited by the floods from the melting ice-sheet. In February, 1885, I walked to and fro over the frozen Delaware, where it reaches a full mile in width, and saw at the time many horses and sleighs passing from shore to shore. I recalled, as I walked, what the geologists have recorded of the river's history, and it was no wild whim of the unchecked imagination to picture the Delaware as a still more firmly frozen stream; so firmly ice-bound, indeed, that the mastodon might pass in safety over it—not cautiously, even, but with the quick trot of the angry elephant—and picture still further a terror-stricken Stone-age hunter fleeing for his life.

Just as our brief yearly winter gives way to milder spring, so, as the centuries rolled by, the mighty winter of the Ice age yielded to changes that were slowly wrought. Century by century, the sun's power was exerted with more telling effect; constantly increasing areas of northward-lying land were laid bare, and the forest followed the retreating glaciers' steps. This great but gradual change had, of course, its influence upon animal life, and many of the large mammals that have been named appear to have preferred the cooler to the warmer climate and followed the ice-sheet on its northward march.

In the unnumbered centuries during which these changes came about, man increased in wisdom, if not in stature, and the rude implements that characterize the lowest known form of humanity —palæolithic man of prehistoric archæology—were gradually discarded for smaller and more specialized ones. This change was doubtless the result of faunal changes that required a compound instead of a simple implement, as an effective weapon—a small spear-head attached to a shaft, instead of a sharpened stone held in the hand; and we find now, as characteristic of conditions geologically later than the gravel beds, a well-designed spear-point, larger than Indian arrow-heads, of a remarkably uniform pattern, and which might readily be supposed to be the handiwork of the historic Indians. But let us examine into the history of these objects a little closely. In the first place, the conditions under which

these rude spear-points are found, as a rule, are very significant. In certain upland fields, never far from water-courses, and which were the high, dry, habitable localities when the later gravel areas were yet comparatively low and swampy, these objects are found in great abundance, and very often not associated with the familiar forms of Indian implements. Again, they also occur in the alluvial mud which has been for centuries, and is still, accumulating over the tide-water meadows that skirt the banks of the Delaware River from Trenton to the sea. Now, it may be maintained that we are without warrant in assuming that the age or object of any given form of stone implement can be determined by the character of the locality where it happens usually to be found—exception, of course, being made to the palæolithic implements of an earlier geological period. To a certain extent this is true. A bead is none the less an ornament, whether dredged from the river-bottom or found in an upland field; and yet how very seldom does any implement or other relic of the Indians occur, except where we should expect to find them! In basing any conclusions upon the characteristic features of a locality where implements are found, it is necessary to determine if there has been any recent general disturbance of the spot. This is readily done usually, and the principal barrier to a logical conclusion is removed. Long experience in archæological field-work has fully convinced me that, in the vast majority of instances, stone implements are practically in the same position that they were when buried, lost, or discarded. A single specimen or even a hundred might mislead; but it becomes safe to base a conclusion upon the locality, when we have the material in such abundance as in this instance of these rude spear-points, and find that fully eighty per cent are from the alluvial mud of the river meadows, or such isolated upland areas as have been described. But more significant than all else is the fact that these simply designed spear-points are all of argillite, the same material of which are made the rude implements found in the gravel. There is, therefore, no break, as it were, in the sequence of events in the occupation of the region by man—no change of race, no evidence of an abrupt transition from one method of tool-making to that of another, but merely an improvement that was doubtless as gradual as the change from the epoch of glacial cold to that of our moderate climate of to-day. What at first sight appears fatal to the views here expressed is that a people so far advanced as to make these spear-points should have made many other forms of stone implements; but only the former are found deeply buried in the mud of the river. If, as is believed, the spears were used in fishing more than for any other purpose, they alone would be likely to be lost. Other objects in use upon their village sites would seldom, if ever, be taken to the fishing-

grounds; and, as a matter of fact, there are found numbers of stone objects of a rude character, usually considered of Indian origin, but which are identical with those used, for instance, by the boreal Chukches. In Nordenskiöld's "Voyage of the Vega" is described a series of stone hammers and a stone anvil which are in use to-day for crushing bones. Every considerable collection of "Indian relics" gathered along our seaboard, from Maine to Maryland, contains examples of identical objects. Of course, the Indians might have used—indeed, did use—such hammers and anvils, but, considering all the evidence, and not merely a part of it, it does not follow that all hammers and anvils are of Indian origin. I have only made incidental mention of the historic Indian, and nothing further is necessary. He plays an important part in our early history, but his origin is yet to be deciphered from many sources. His arrival in the river's valley dates, as we reckon years, long, long ago; but no evidence is as yet forthcoming that it was prior to the valley's practically present physical aspect.

Let us consider these rude argillite spear-points, and the circumstances under which they occur, a little more closely. In this magazine (January, 1883), I based the opinion that these objects were of an earlier and other than Indian origin, because of their occurrence in so many localities at a depth greater than that at which jasper and quartz arrow-heads are found. In other words, the plow unearths the Indian relics in great quantities; but, by digging deeper, objects of argillite are found in significant numbers. In this earlier communication to the magazine, reference was made only to scattered objects; but now I propose to call attention to strictly surface-found specimens, where they have been discovered in such abundance as to plainly indicate the former sites of camps or villages. If such localities are really pre-Indian in origin, then it remains but to consider the fate of this earlier people; but, before indulging in speculation, what of the facts? The results of my labors may be summed up in a brief account of a visit to one locality; for all subsequent and preceding visits to distant points resulted similarly.

In two instances, collections which I studied were of such magnitude, and had been brought together with such care, that they had a decided bearing upon the question. The particular fields from which the great bulk of the specimens had been taken were studied most carefully, and it soon became evident, in each case, that the reported commingling of all forms of stone implements was more apparent than real. The physical geography of each locality plainly showed that for a very protracted period these spots had been habitable and inhabited. It was evident, in each case, that a very undulating surface had existed, through which meandered a small stream that had long since disappeared. These

areas of hillock and dale had been densely wooded, with here and there a little clearing; and now, for nearly two centuries, plowed over almost every year. What, then, should we expect, presuming that the relics of two peoples had been left upon a tract of some two hundred acres? First, the tract was deforested, which would lead to much disturbance of the surface soil; secondly, the stumps of the trees were uprooted, which would lead to a greater disturbance; and, lastly, constant plowing, exposure of a raw surface to winds and rain, and the erosion due to the flooding of the stream that drained the tract, would result inevitably in the moving of objects, as small as arrow-points, to considerable distances from where they were left in Indian or pre-Indian times. It would be strange indeed if any evidence of earlier and later occupancy had withstood such vicissitudes; and yet such was the case. The highest ground afforded ninety per cent of the specimens I was able to find, of argillite; while in the low-lying area of the one-time stream's tortuous bed the argillite and jasper implements were commingled, with a preponderance of jasper and quartz in the ratio of seven to two. It was evident that the washing down of the higher ground and partial obliteration of the valley had transported the argillite and mingled it with the jasper, and not generally commingled and brought to certain points the equally scattered objects made of these minerals. During the summer of 1887 a very careful and intelligent observer reported to me that, in a field not far from where I live, he had found a considerable deposit of argillite chips, rude arrow-heads, and bits of pottery; but that there was no trace of jasper or quartz, or indeed of any other mineral. As I had collected Indian relics by the hundreds, in this same field, I refrained from visiting the spot, but requested my friend to examine the locality again with great care, and report to Prof. Putnam, of the Peabody Museum at Cambridge, Massachusetts. What was the result? My friend reported, briefly, that the spot was one uncovered by heavy rains, and formed part of the bank of a brook that crossed the field (this brook, I would state, was a considerable creek in 1680); that the argillite chips, rude arrow-points, knives, scrapers, and bits of pottery were found at a common level, and about fifteen inches below the present surface of the field. Prof. Putnam, in acknowledging the receipt of the specimens and report as to their discovery, replied that the pottery was of unusual interest, as it was exceedingly rude and differed very greatly from any that Dr. Abbott had sent from the same general neighborhood. As the bits of pottery from this general neighborhood that I have collected amount to hundreds of thousands, it would seem that Prof. Putnam's remarks have a good deal of significance.

As having a most important bearing upon this general question,

it is well to refer to the results of others' labors in the same general field. In an address before the American Association for the Advancement of Science, at its Cleveland (Ohio) meeting, August, 1888, I referred to the Lockwood collection, now at the Peabody Museum at Cambridge, Mass. This series of ancient stone implements is one of exceeding value, because the objects are nearly all from shell-heaps on the coast of New Jersey. When arranging this collection, I was much impressed with the fact that the argillite implements, of which there were many considerable lots, were all labeled by Prof. Lockwood as having been found alone—i. e., not associated with similar objects of jasper or quartz; and again, that with the argillite was much very rude pottery, that bore little resemblance to the fragments of earthenware found in other places associated with the jasper, quartz, and chert implements. Subsequently, Prof. Lockwood informed me that, while these various finds did not vary in depth, they were very marked otherwise, and he did not recall any special "find" where the commingling of the two forms indicated that they had been in use at the same time.

Taking a hint from little brooks and the surrounding fields, let us consider, in conclusion, the more pretentious rivers and their surrounding uplands. Will the same results be obtained? Can we venture to reach out from the particular to the general? These were the questions that I frequently asked of myself, and, after many a weary tramp and toilsome digging over a wide area, I am happy to state that I believe my efforts have been crowned with a full measure of success. What held good in a particular field holds good of a county, and what I now claim for the tide-water portion of the valley of the Delaware I believe is true of a much more extended area.

In no case have I been able to find stone implements significantly distributed over a considerable space—i. e., tracts of five hundred to a thousand acres—except where there was, or very recently had been, running water. The ground, then, to be examined was either the high land that shut in the valley, or the valley itself, limiting that term to the banks of the stream and the immediately adjacent meadow tracts; exception being made where the bank of the stream was and always had been very precipitous. In such a case the brow of the bluff would be equivalent to the meadow or low land of a gently sloping valley.

In every such instance—and I have made or have had made many careful examinations of river and creek valleys—the result was the same: a very marked preponderance of argillite implements on the crests of the uplands, and a very great excess of jasper and quartz on the bottom land, or that directly adjacent to the stream. From this condition I am led to infer that, when

these higher points were occupied, the present streams maintained a uniform flow as high as the freshet stage of these watercourses; and the fact that an Indian village site near by will be much nearer the river or creek shows clearly, I hold, that on a small scale the same conditions were repeated that occurred in the gradual change from glacial to post-glacial times. The volume of water in all our streams, comparing century with century, is gradually lessening.

Comparing then the rude objects of argillite, specialized as they are, with the magnificent flint-work of the historic Indians, I would designate the former as *fossil implements*, the latter as *relics*.

To this point I feel that I have been handling facts only, and deducing from them only logical inferences; but now looms up the natural and ever-interesting question, Who were these people? The origin of any race is a difficult problem to solve, but none can compare with these misty vestiges of prehistoric humanity. It seems to me but one inference is permissible: they who fashioned these rude argillite implements were the descendants of palæolithic man, and his superior in so far as a knowledge of the bow and arrow and rude pottery indicates. Beyond this, perhaps, we can not safely venture. Prof. Haynes has recently observed, "The palæolithic man of the river gravels at Trenton and his argillite-using posterity the writer believes to be completely extinct." While this at present seems to be the generally accepted conclusion, there is a phase of the subject that merits consideration. May not this "argillite-using" man have been a blood-relation of existing Eskimos? To accept the view of Prof. Haynes that "argillite" man became extinct infers an interval of indefinite length, when man did not exist on our central Atlantic seaboard; but if we may judge from the abundant traces of man that have been left and of the relation as to position that these three general forms, palæolithic, later argillite, and Indian, bear to each other, it would appear that, in the valley of the Delaware, at least, man has not for a day ceased to occupy the land since the first of his kind stood upon the shores of that beautiful river.

By referring these intermediate people to the existing Eskimos, I would not be understood as maintaining that these boreal people were directly descended from the argillite-using folk of the Delaware Valley, but that both were derived from palæolithic man; in other words, that with the disappearance of glacial conditions in the Delaware valley, and the retirement northward of the continental ice-sheet, if such there were, the people of that distant day followed in its tracks, and lived the same life their ancestors had lived when northern New Jersey was as bleak as is Greenland today; but that not all of this strange people were so enamored of

an arctic life, and that many remained and, with the gradual amelioration of the climate, their descendants changed in their habits so far as to meet the requirements of a temperate climate. This explanation, it seems to me, best accords with known facts.

It is fitting, after a long tramp in search of human relics or remains, still so abundantly scattered over and through the superficial soil, to halt, at the day's close, upon the river's bank, and rest upon one of the huge ice-transported bowlders that reach above the sod. From such a point I can mark the boundary of the latest phenomenon of the valley's geological history, and seem to see what time the walrus and the seal sported in the river's icy waters; what time the mastodon, the reindeer, and the bison tenanted the pine forests that clad the river's banks, and what time an almost primitive man, stealing through the primeval forests, surprised and captured these mighty beasts—what time, lingering by the blow-holes of the seal and walrus in the frozen river, surprised and killed these creatures with so simple a weapon as a sharply chipped fragment of flinty rock. And, as the centuries rolled by, and the river lessened in bulk, until it but little more than filled its present channel, there still remained along its shores the more cultured descendants of the primitive chipper of pebbles. As a savage, so like the modern Eskimo that he has been held to be the same, this pre-Indian people still wrought the argillite that their ancestors were forced to use for their palæolithic tools; and as these spear-points are being gathered from the alluvial deposits of the more modern river, I can recall to their accustomed haunts this long-gone people, who, ere they gave place to the fierce Algonkin, were the peaceful tenants of this river's valley. Then, as we gather the beautiful arrow-heads of jasper and quartz, and pick from superficial soils grooved axes, celts, chisels, curiously wrought pipes, strange ornaments, ceremonial objects, and fragments of pottery, literally without number, we marvel at the skill of those who wrought them, and faintly realize how long these comparatively recent comers must have dwelt in this same valley, to have accumulated such an endless store of these imperishable relics.

We rightly speak of the antiquity of the Indian, but, remote as is his arrival on the Atlantic coast, it is modern indeed, in comparison with the antiquity of man in the same region. We can think of it, and perhaps faintly realize it, as "time relative," but in no wise determine it as "time absolute."

Dr. Burdon Sanderson foresees another division in science. He observes, in a biological paper in the British Association, that morphology and physiology have now diverged so widely, as regards subject and method, that there seems to be danger of a complete separation of one from the other.

GLASS-MAKING.

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III.—THE EVOLUTION OF A GLASS BOTTLE.

TO a little sand, a little alkali, and a little limestone, add considerable heat and a still greater amount of skill, might be taken as a brief recipe for the manufacture of a glass bottle.

But to know in just what proportions to mix these several ingredients, how to produce and manage the requisite heat, and particularly how to cultivate that most essential part of the whole process, the manual dexterity which gives value to these other factors, are matters less briefly disposed of. Their consideration has made the evolution of a glass bottle a history covering several thousand years. The importance of this modest process will appear, if one is not already persuaded of it, when one recalls for an instant the multitudinous uses to which bottles are now put. It is difficult to fancy the confusion which would result were so simple an article of commerce suddenly withdrawn from the world of fact, and society called upon to manage without its service. Great would be the consternation of a host of manufacturers, and loud the outcry of a larger host of consumers.

The earlier man, it is to be remembered, had his herds always with him, his spring of water near his tent-door. He knew no tonic save the air of the desert, and few other beverages than the wine which was stored in sacks of goat's skin. To him bottles and their contents were matters of little moment. It is true that, in the storage of the one liquid which he preserved in this way, he did have to be careful not to put new wine into old bottles, but the proverb was easily recalled, and its precaution not difficult to carry out. He contented himself with his sack of skin, and found, in the projection which had once been the leg or neck of the animal, a mouth to his bottle sufficiently convenient to serve his purpose.

It was from receptacles such as this that the tired heroes of the *Iliad* regaled themselves, and the aged Noah partook too generously.

Even now this primitive bottle is largely used for the transportation and storage of water by the people of western Asia, and the usage seems to possess enough inertia to carry it forward several centuries further. Invading Americans may find the bottle of skin still in vogue, when their restless westward-moving activity carries them across the Pacific.

The substitution of glass bottles was effected but slowly even among the more progressive of ancient peoples. In the use of

glass, the idea of beauty and decoration long remained paramount to considerations of utility. It was an article of luxury rather than of necessity. Darwin observed with amazement that when the weather was warm and fair, the Fijians paraded their coats of furs and feathers with all the pomp and pride of the Parisian *beau-monde*, only to stand naked and shivering in times of storm. It seems to have been much the same thing among the ancients with respect to their glass bottles. It was ornament in place of use. They were quite willing to get along without them in the economy of every-day life, provided they could have a few rare vases and gold-mounted amphoræ in the early *salons* where Rameses gossiped about Egyptian politics, and Potiphar discoursed upon the mysteries of metempsychosis.

It must be confessed that, in the pursuit of this one idea, they were eminently successful. Their glass trinkets were beautiful, both in outline and in color, even if their bottles for real service were made of skin, and liable to rip and tear. The glass *bric-à-brac* of antiquity, its bottles and vases and jars, was not of large dimension, but it possessed a profusion of color which we have only of recent years been able to imitate.

With us moderns, however, life is much more complex, and the case is quite different. We are not insensible to ornamentation, but we are more keenly alive to comfort. In the absence of a king's taster, we are disposed to guard what we eat and drink. The majority agree with Charles Lamb, that poisoning is "a nasty death," and so we eschew the use of metals in contact with our foods, and much prefer glass. We want milk miles from where it is produced, and fruits and vegetables months after their harvest. We want medicines for health, balms for bruises, tonics for appetites, mineral waters for digestion, wines for strength, condensed products for our travel. We want to separate with acids and put together with glues. We want a host of other things which come in bottles. We even bottle our electricity—if so unscientific an expression may be applied to the storage-battery. There is, in fact, scarcely a single department of life, either social or industrial, where some product is not needed which must be kept or carried in some form of glass bottle or jar. The manufacture of so useful an article is thus brought into relation with all of our many-sided activity. It forms a distinct and very important branch of the glass industry.

In America, the process of bottle-making is nowhere carried on more extensively or more successfully than in the neighborhood of Philadelphia. Much of the sand of southern New Jersey is sufficiently pure to make an excellent bottle-glass. Its adaptability for this purpose seems to have been appreciated by the early colonists, for the oldest glass-works in this country are those es-

tablished in 1775 at Glassboro. They are still in operation, and are at the present day the most extensive of American bottle-works, employing as they do some six hundred persons in the conduct of their operations. It is a significant fact, showing the force of modern progress, that after existing for more than a century, the capacity of the "plant" was increased over fifty per cent during a recent period of three years. It is one of several establishments which have grown up in that neighborhood, and which have been attracted by the same cause, the abundance of a fair quality of sand. There is, moreover, something highly gregarious about modern industries. It frequently happens that many other localities offer quite as favorable conditions as the one selected; but the simple presence of a successful industry seems to turn men's thoughts in that direction, and lead them to undertake similar enterprises rather than to attempt the dangerous experiment of importing a new manufacture. To this principle of gregariousness, as well as to the wide wastes of sand, must the community of glass-workers in southern New Jersey be attributed. Like apparently begets like.

FIG. 1.—A GLASS-BOTTLE FACTORY IN SOUTHERN NEW JERSEY.

There is little that is attractive about the exterior of such a bottle-factory. One finds it set down in the midst of a flat, monotonous country, and surrounded by indifferent wooden houses with bare, sandy door-yards which bespeak small appreciation of the element of beauty. That these houses are homes, and are for the most part owned by those who live in them, adds immensely to their interest, but it does not conceal the fact that life here is

material and ugly. It is not a beautiful or an inspiring thing to blow bottles all day long, unless one does it remarkably well; but the industry remaining, the life in these towns might still be made much less bare than it is, could that gospel of happiness and culture which Mr. Walter Besant and others are preaching in the East End of London find here some good apostle who would make it the burden of a new evangel.

In the larger bottle-works there are generally several melting furnaces, but each is complete in itself, a unit from which a larger or smaller plant may be constructed, according to the requirements of the case. Each furnace is lodged in its own building. A certain symmetry is loaned to these low, rectangular wooden structures by the tall brick furnace-shaft which rises through the center of the roof, and by the numerous smaller chimneys scattered around the edge. The sides of the building are movable on pivots, and when open give the factory somewhat the appearance of the Japanese houses pictured by Mr. Morse.

Inside of the factory all is life and movement. But, amid the dirt and confusion which characterize such an interior, there are the order of active money-getting and the beauty of a long-practiced dexterity.

If one follow the crude materials from the time they enter the building until they finally emerge in the form of many-shaped bottles, he will begin his inspection at the mixing-room, where the questions of content and proportion are decided. Large wooden wheelbarrows come and go, stopping long enough only to have their weight taken, and to dump their thoroughly ground contents into one of the bins on the side of the room. Patient old men, with hoe and shovel, mechanically mix together the stuff for the "batch." This varies in its composition according to the sort of bottles that are to be made. Three grades of bottle glass are recognized. The ordinary green glass is obtained from a mixture of about thirty-eight parts of soda and twenty parts of marble-dust to every hundred parts of sand. The glass is essentially a lime-soda glass, not dissimilar to window glass in its composition. The sand used comes from the neighborhood, and contains a little iron. As no bleaching agents are employed, this gives the glass its characteristic light green color—the bottle-green of our colorists. The second grade, the amber glass, has about the same composition, only it is colored by the addition of a little ground coke, black-lead, or some other form of carbon, about eight ounces to every hundred pounds of sand. This makes a much less innocent-looking bottle than the sea-green tint of the first glass. The finest grade, the so-called flint glass, contains about the same ingredients as the ordinary bottle glass, but the materials used are purer, and some such bleaching agent as manganese dioxide,

arsenious acid, or nitrate of soda is used to make the glass colorless. Blue bottles are occasionally wanted, and in that case a little peroxide of cobalt is added to the customary batch to give the required color.

To obtain the best results, it is essential that the grinding and mixing of the crude materials be carefully looked after. At Glassboro the mixing as well as the grinding will soon be done by machinery in one central mixing-room, and the batch conveyed to the different furnaces by means of endless belts. It is believed that this improvement will insure a better product as well as more economical working.

The batch having been prepared, the next step in the development of the bottle is to change this dull-white powder into clear, fluid glass. Such a metamorphosis is accomplished in the melting furnace, which forms very naturally the central feature in a bottle-factory. The gratifying increase in the capacity of the Glassboro works is largely if not entirely due to the introduction of improved furnaces invented by the chemist of the works, Mr. Andrew Ferrari. They are continuous tank furnaces heated by gas—that is to say, the melting is carried out in large fire-clay tanks, and proceeds without interruption. There are other tank furnaces in use in America, but these are probably the only works where the melting is carried out continuously. Neither the employment of a tank in place of separate crucibles, nor the substitution of a gaseous for a solid fuel, is in itself new; but the details of the Ferrari furnace are quite novel. In Europe, the regenerative system of Siemens has been employed with marked success in the manufacture of glass; but, unfortunately, the Siemens furnaces are expensive in their construction and require some degree of skill to insure their best working. The Ferrari furnace, on the other hand, is an inexpensive affair and is easily worked. The gas generator is the usual inclined or "step" grate employed by Siemens, but it is placed directly alongside of the furnace, thus obviating the transportation of the gas, and the consequent necessity of reheating it before combustion.

At one end of the building one sees an elevated platform on which are stacked large blocks of bituminous coal. About six tons are daily required for each furnace. From this platform a line of low, irregular brick-work extends to the central stack. It contains the gas generators, three to each furnace, and beyond them the melting tank, which communicates on the other side with what is known as the working part of the furnace, lying directly under the central stack. The coal is fed directly into the generators from the platform, and on the inclined grate is completely burned—that is to say, it unites with all the oxygen possible, forming carbonic-acid gas. The supply of air may be regulated

by dampers, so that the generator yields more or less gas according to the requirements of the furnace. But the carbonic-acid gas thus produced would be of no value as fuel, for it is totally incombustible. Rising, however, through the mass of incandescent fuel above it, the gas is speedily reduced to the condition of carbonic oxide, that combustible gas whose blue flame plays over

FIG. 2.—AN INTERIOR VIEW, SHOWING THE BRICK-WORK WHICH CONTAINS THE GAS GENERATORS AND MELTING TANK.

the surface of an anthracite fire just after fresh fuel has been thrown on. This mixes with the volatile hydrocarbons—the coal-gas given off when fresh coal is introduced into the generator—and the mixture passes at once to the chamber above the melting tank. The air necessary for the burning of these generator gases is first heated by passing through a number of chambers in the lower part of the furnace. It is mixed with the gases to be burned just before they reach the fire-clay bridge separating the gas generator from the melting tank. The main combustion takes place right at this bridge, and produces an intense heat in the melting chamber, for both the gas to be burned and the air to burn it are highly heated before they are allowed to combine. The effect is the same as would be produced on a small scale if one fed his stove with the hot air from a register. This arrangement removes in a simple and inexpensive way one of the chief objections to the use of gas in glass-making. The fuel is so exceedingly convenient that its use in the industry was proposed, and indeed attempted, years ago, but a sufficiently intense heat could not be thus obtained.

The furnaces are in continuous operation for ten months in the

year. Every three hours during the entire twenty-four a charge of a ton and a half of the batch is added to the melting tank. In an atmosphere so intensely heated as this, it does not take very long for the crude materials to fuse and form a glass quite as liquid as water.

Picture for a moment the white-hot caldron in which this transformation of the opaque into the transparent takes place. It is an oblong tank, some eight by ten feet, in which the glass in various stages of fusion stands to a depth of nearly three feet. Above this seething mass there is a low arch which deflects the long, curling flame as it comes over the bridge from the generators, until it bathes the entire contents of the tank in its Plutonic breath. As the materials of the batch unite and melt—alone, they would be for the most part entirely infusible—the liquid glass sinks to the bottom of the tank and flows through small openings into the gathering chamber beyond. The glass resulting from the union of sand and alkaline bases is heavier than the crude materials from which it is formed, and consequently seeks the lowest level. In this way the tank, although filled with material in all stages of transformation, has always at the bottom a bath of thoroughly fused glass. The communication between tank and gathering chamber is arranged at such a level that the fluid glass alone can pass from one to the other.

This central gathering chamber and the busy life surrounding it are the points of chief interest to the visitor who wishes to see the scenic part of bottle-blowing, and is willing to take the chemistry and some of the more occult parts of the process on faith. The chamber itself is circular, usually about sixteen feet in diameter, and contains a bath of molten glass nearly two feet deep. The temperature of this fiery lake is kept above the fusing-point by the hot gases which come from the melting tank and rise into the high shaft immediately over the gathering compartment. It takes only from two and a half to three hours for the crude materials of the batch to pass to the condition of perfectly fused glass. This is pretty quick glass-making.

A little sand, a little alkali, a little limestone, and considerable heat have so far been expended, and the result is fluid glass. It is that greater amount of skill which is now needed to transform the glass into a bottle.

There is a series of openings, some sixteen in number, around the sides of the gathering chamber and a little above the level of the molten glass. Through these the glass-blower draws his supply, but he does not dip his blowpipe directly into this glowing reservoir. Such an arrangement would cause too great a loss of heat, besides interrupting the furnace-draught, and would be a source of constant annoyance to the gatherer on account of the

impurities which float as a scum on the surface of the bath. To avoid these evils, each gathering hole has its "boot," a rounded hood of fire-clay which surrounds the hole on the inside of the chamber, and extends downward to the bottom of the bath in the shape of an oval cylinder. An opening near the bottom of the cylinder admits the fluid glass into the interior of the boot, and

FIG. 3.—THE OPERATION OF "MARVERING."

permits it to stand always at the same level there as in the gathering chamber outside. Thus the gatherer draws his burden from this little bucket-like reservoir, but, like the widow's cruse of oil, the supply never gives out.

Outside of the furnace the agencies of heat and chemism are replaced by that of human dexterity. The men work in companies, which are known in the glass-maker's parlance as "shops." And very busy companies they are. They resemble nothing so much as a swarm of bees, as they hurry to and fro about the gathering holes. The condition is one of almost nervous activity. The men toss their blowpipes hither and thither in the operation of forming the bottles, and boys dart in and out of the crowd carrying bot-

tles in all stages of development. There is complete singleness of purpose. They are all intent on turning out the largest number of bottles possible—for the pay is largely by the piece. Where the bottles are very small, one man has been known to blow as many as two hundred dozen in a day, but this is exceptional activity.

There are, all told, seven persons in such a shop: three men, of whom two blow the bottles, while a third, the gaffer, forms the necks, and four boys who gather the molten glass, open the molds, and carry away the finished products. The gatherer is a somewhat older boy than the others, and stands in direct line of promotion; is, in fact, a blower or gaffer in embryo. He aspires—the others but distantly. One shop is attached to each boot; and occasionally, when work presses, there are two shops to a boot, but this is rather crowding things and is not favorable to the best working. The process begins with the gatherer. His blowpipe is a tube of wrought iron, five or six feet long, and of lighter weight than the pipe used in blowing window glass. He dips the end of his pipe into the molten contents of the boot, and brings out a mass of red-hot plastic glass. If the bottles to be blown are small, one gathering suffices, but, for larger wares, two or even three gatherings may be necessary to get the requisite supply of material on the end of the blowpipe. When the gathering is done properly, this lump of red-hot glass is a perfectly homogeneous mass. Its subsequent fortunes rest with the blower. He takes the blowpipe from the gatherer, and, resting the plastic glass against a marvering table of stone or cast iron, he gives the pipe a few adroit rotations, thus fashioning the glass into an even cylindrical shape. By further rolling it along the edge of the table he forms the smaller prolongation of glass which is afterward to become the neck of the bottle. Lifting the still red-hot glass from the table, he blows through the pipe, forming a small bubble of air in the interior of the mass of glass. This is afterward extended until it becomes the inwardness of the bottle.

The partly fashioned bit of glassware is now introduced into the mold which one of the "shop" boys has already opened to receive it. For convenience in working, the mold is placed on a somewhat lower level than that on which the blower stands. It is made of cast iron, and is commonly formed in two pieces. One of these is stationary, while the other opens outward, its motion being controlled by a foot-lever. When the blower places his incomplete bottle, still attached to the blowpipe, into the mold, he closes the mold with his foot, and blows through the pipe until the plastic glass is everywhere forced against the sides of the mold, and has impressed upon it the form of its prison. Then with a quick motion the blower detaches his blowpipe from the

projecting neck of the bottle—the glass is still plastic—hands it over to the gatherer, and with a fresh blowpipe repeats his labor. Such constant blowing largely develops the muscles of the cheek, but the exercise is not unwholesome. It is impossible by methods like these to obtain bottles of uniform thickness, yet the variations are much less than one would suppose.

FIG. 4.—PUTTING THE BOTTLE IN THE MOLD PREPARATORY TO THE FINAL BLOWING.

In contact with the iron of the mold the bottle cools very rapidly. Almost as soon as the blower takes away his pipe, the mold may be opened and the bottle removed. The little fellow who does this is called a "snapper." He seizes the bottle with his iron forceps and transfers it from the mold to a pair of scales near by. A small square of asbestus cloth remains permanently on the scale-pan, as contact with the cold iron would be apt to crack the glass. All bottles, except the very small ones, are thus weighed, and any that show either a deficiency or an excess in weight are rejected. There will always be a slight variation, but it must be within narrow limits, not exceeding, for instance, an ounce in bottles intended to weigh seventeen ounces. Comparatively few bottles are

rejected for this cause. The bottle of approved avoirdupois is placed in a closely fitting case of wrought iron mounted on a long handle. Only the neck of the bottle is allowed to project. Thus blanketed and mounted, the hot glass is easily handled.

It goes now to the gaffer, to have its neck properly shaped. He is found at no great distance, sitting before a little side furnace which affords three openings—"glory-holes"—large enough to admit the necks of the bottles, and a heated atmosphere of sufficient intensity to make the glass necks plastic and workable.

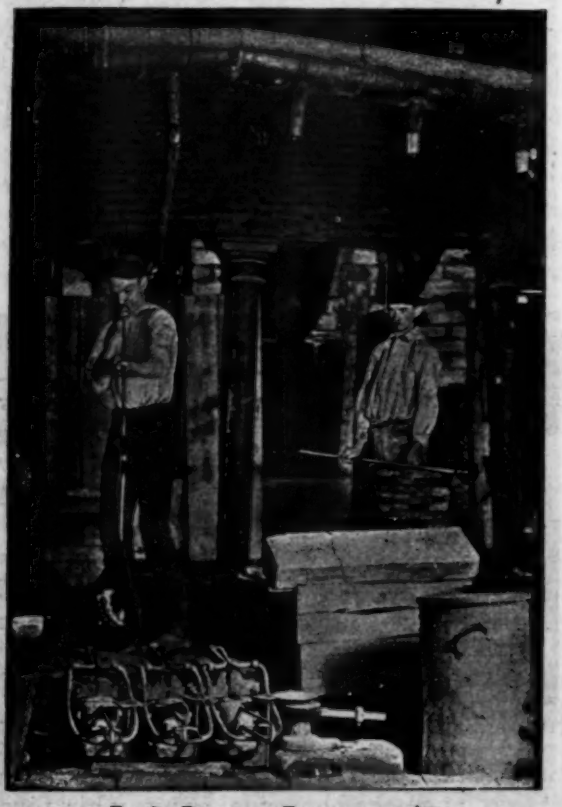

FIG. 5.—BLOWING A FLASK IN THE AIR.

Crude petroleum is the fuel used. It is stored in a tank to one side of the furnace, and trickles down, drop by drop, into a tube which brings a strong blast of air from a distant fan. In this way the oil is vaporized, and mixed with such proportions of air that the mixture is highly combustible, and in burning produces an intense heat. Three tongues of yellow flame thrust themselves out of the glory-holes and leap toward the gaffer sitting before them. In England this member of the shop is known as the chairman, a term which refers to his bodily rather than to

his official position. He thrusts the necks of the incased bottles into the glory-holes, and then one by one withdraws them from their aureole and forms the necks. This he does by means of a convenient implement known under the generic name of tool. It consists of a central stopper, kept moist with oil, which is thrust into the mouth of the bottle, thus determining its gauge; and of two outside arms of iron, which, by the rotation of the case, the tool remaining stationary, form the smooth ring commonly adorning the necks of glass bottles. The gaffer, like the blower, is a quick workman, and does the finishing for both blowers belonging to his shop. He does not leave his chair, the glass being brought to him and carried away again by the little boys who have been noticed as darting about in such a lively fashion.

The bottle is now finished, so far as its form is concerned, but, like the window-pane under similar circumstances, it would have scant value if sent out into the world in its present condition. It would be too brittle, on account of its sudden cooling, and must therefore first be annealed. This operation is simply one of gradual cooling, and is carried out in ovens or in annealing leers.

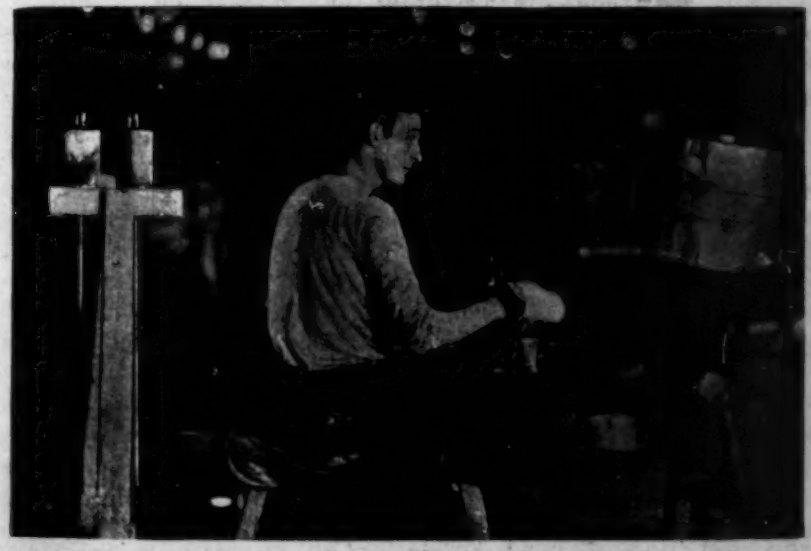

FIG. 6.—A VIEW OF THE GAFFER AT WORK, SHOWING HIS TOOL AND MANNER OF HOLDING THE BOTTLE WHEN FORMING ITS NECK.

The oven is a roomy chamber of brick-work, in which a wood fire is permitted to burn for a couple of hours in the early part of the day. It is opened when the blowers begin work, and during the remainder of the day it is gradually filled with bottles as the different gaffers finish them. At night it is closed and permitted to remain so for three days. At the end of that time the oven has become quite cold, and the bottles are thoroughly annealed.

The leer is a later invention and carries out the same process, only it acts continuously and is in so far an advance. It also consists of a roomy chamber of brick-work, but the fire is permanent and is located at one side of the chamber. A long brick passage-way extends for eighty feet from the back of this receiving chamber. The bottles are not piled directly on the floor, but are placed in low sheet-iron cars which move on a track extending the length of the passage-way. As soon as a car is filled, it is moved along the passage-way in order to make room for an empty car in the receiving chamber. In this gradual way the loaded cars are moved along the passage farther and farther from the source of heat, and finally discharge their loads at the cold end of the leer. It takes from forty-eight to sixty hours to accomplish the journey, though this is simply a matter of convenience, as the annealing process itself would not require more than from nine to ten hours, if so long as that.

Ordinarily the bottles, just as they come from the ovens and leers, are ready to be packed and shipped to their purchasers. In case, however, a seal has been blown in the side of the bottle and its prospective contents are of an effervescent character, the strength of each bottle must be carefully tested, as the glass forming the seal is apt to blow out thinner than the rest, and thus be a source of weakness. The testing is carried out by filling the bottle with water and then subjecting it to the pressure of a column of water equal to eighty pounds to the square inch. Only a few of the bottles, however, break under this ordeal.

But in case the bottle has a screw top, as in fruit-jars and the like, or is to have simply a plain ground edge, as in electric-battery jars, it is manufactured with a slight excess of glass on the top. This is known as a "blow-over." In this event the bottle does not pass through the hands of the gaffer, but goes directly from the blower to the ovens or annealing leers. In the grinding department the blow-over is knocked off and the rough edges ground smooth in a rotary grinding machine. In this the bottles or jars are put in upside down, eleven at a time, and have their edges pressed against the face of a large horizontal iron wheel which is rotated by steam-power. The framework in which the jars are held also rotates, and, in addition, each individual jar turns on its own axis. The iron wheel is supplied with a constant stream of sand and water, and this, with the triple motion of the machine, does very effective work. As many as sixty dozen jars can thus be ground in an hour.

The products of such a bottle-factory are as varied as the processes by which they are fabricated. There are large bottles and small bottles, tall bottles and short bottles, thick bottles and thin bottles, ugly bottles and pretty bottles—in fine, all sorts of bottles,

according to the taste and requirements of the purchaser. He may order anything, from the tiny vial of one-drachm capacity up to the ungainly carboy holding fourteen gallons. He may have any tints desired, from the colorless flint glass through all shades of green and brown and blue to the bottle of absolute blackness. Or

FIG. 7.—THE ANNEALING LEER, AS SEEN FROM THE FRONT.

he may have any shape or form he pleases. Few if any bottles are kept in stock or made until ordered. Nearly all of the work is the direct filling of orders.

It is only by comparison with the older order of things that one can appreciate the large improvements that have recently been introduced into the process of bottle-making. In the Glassboro works the Ferrari furnace has effected many changes and many economies. I am told, on very reliable authority, that not only is the quality of the glass much improved by the employment of these furnaces, but that in addition the experience of five years has shown their maintenance and operation to be notably less expensive than the old-style pot furnaces. In the matter of fuel the saving is said to have been more than fifty per cent. The repairs have also cost as much less in proportion. When the melting was done in pots, the cost of these alone made an appreciable item in the year's expenses. Each one cost about fifty dollars, and their average life was only two months. Occasionally one was known to last nine months, but for every such exception there were from two to three dozen which failed in less than a month. The four furnaces in operation would require in all about forty pots, and these renewed every two months would mean during the

working year an expenditure for pots alone of ten thousand dollars. The present tank furnaces are out of blast during July and August, but the year's repairs are only a nominal expense. The hot season is chosen for renovation for very obvious reasons, though the heat alone is not sufficiently intense to make the cessation of work a necessity.

In thus following the evolutionary process by which a glass bottle is produced, one meets with many ingenious contrivances and many shrewd adaptations of means to ends, but he will scarcely meet with any problem of quite such deep interest as that presented by the people who carry out this process. Particularly is one struck with the large number of boys, scarcely more than children, who are employed in such a factory. About the furnace proper there are even more boys than men. The law does not permit the employment of children under twelve years of age, but exceptions are sometimes allowed by the labor inspector in case a boy has a widowed mother, or some other particular demand upon his early activity. New Jersey further attempts to protect her children by making an annual school attendance of five months compulsory for them. In the glass-blowing districts this requirement is met by the establishment of night schools supported by the State. The term lasts only for the allotted five months, the daily session being for two hours, from half-past six to half-past eight o'clock. My own limited observation of the working of night schools has led me to believe that they are but poor substitutes for work done earlier in the day when the boys are fresher and more buoyant; but the superintendent of a large factory, to whom I spoke on the subject, was of the opinion that these childish glass-workers are doing very satisfactory work in such schools. It is hard, nevertheless, that childhood should be made so short, and that the work-a-day life should begin so early for these little people. They seem, it is true, a very happy, merry set of youngsters, and, if one may judge from the tricks they are constantly playing on one another, they manage to get a fair share of boyish fun; but they can not fail to lose much in being so soon harnessed. As a class, these lads seemed to be finer looking and in many ways better conditioned than the older workers, so that one would naturally fancy that the hard work was leaving its landmarks. Men who have known them longer tell me, however, that it is a new generation, and one that has been reared under more favorable conditions of life.

They are comparatively well paid. The little boys make three dollars a week, and the larger ones six; modest sums admittedly; but large enough under the circumstances of country life to permit a little laying by. I felt curious to know what aspirations were most favored in such a community, and to what ideals the

boys looked up. The story was soon told: to become glass-blowers, and to have plenty to eat—that was all; a life centered about bottles. Yet, among so many bright-faced lads, there are doubtless many of considerable promise, could their imaginations only be fired by some well-directed effort. Some one with a passion for culture and a big human heart could do great things, it seemed to me, with such quick, observant material.

With the older workers the dice have been cast, and life is well crystallized. It has left them divided into two classes: the green-glass blowers, who are chiefly Americans, and the flint-glass blowers, who are more largely Germans. Both bodies of men are closely organized, and as a result make excellent wages. The union to which they belong will not permit more than two apprentices a year to a single furnace. Such a regulation, with the annual increase of the industry and the inevitable deaths, practically excludes competition. The blowers make on an average five dollars a day. In rare cases as much as three hundred dollars a month has been paid to a single man. So large returns, however, are only possible for blowers and gaffers. The other members of the shop, as well as the numerous helpers employed in the conduct of such large enterprises, receive regular wages.

One other feature deserves mention. Throughout the entire works there is observable that marked tendency of modern industrial life to substitute continuous, automatic processes for those which are periodic and manual. The continuous annealing leer is taking the place of the oven; the steady flow of gaseous fuel is replacing the oft-repeated shovelful of coal; the continuous melting tank has been substituted for the discontinuous reservoir system represented by the crucible pots; the uninterrupted automatic charging of the furnace is about to do away with the manual feeding of the batch every three hours; and similarly, in all departments, the change is in progress. The operations of blowing have not yet been made automatic. Bottles but an inch long are still produced by the blower's breath, and little boys dispose of them one by one. But it is not improbable, in spite of the difficulties in the way, that a patent bottle-blowing machine will some day take the place of the army of workers who now swarm around the gathering chamber of a glass-furnace. Such a machine already exists in the brain of a man. When it is materialized into a working fact, the last step in perfecting the evolution of a glass bottle will have been taken, and any further development will be along lines already laid down.

PLAIN WORDS ON THE WOMAN QUESTION.

By GRANT ALLEN.

IF any species or race desires a continued existence, then above all things it is necessary that that species or race should go on reproducing itself.

This, I am aware, is an obvious platitude; but I think it was John Stuart Mill who once said there were such things in the world as luminous platitudes. Some truths are so often taken for granted in silence, that we are in danger at times of quite losing sight of them. And as some good friends of mine have lately been accusing me of "barren paradoxes," I am anxious in this paper to avoid all appearance of paradox, barren or fertile, and to confine myself strictly to the merest truisms. Though the truisms, to be sure, are of a particular sort too much overlooked in controversy nowadays by a certain type of modern lady writers.

Let us look then briefly at the needful conditions under which alone the human race can go on reproducing itself.

If every woman married, and every woman had four children, population would remain just stationary. Or rather, if every marriageable adult man and woman in a given community were to marry, and if every marriage proved fertile, on the average, to the extent of four children, then, under favorable circumstances, that community, I take it, would just keep up its numbers, neither increasing nor decreasing from generation to generation. If less than all the adult men and women married, or if the marriages proved fertile on the average to a less degree than four children apiece, then that community would grow smaller and smaller. In order that the community may keep up to its normal level, therefore, either all adults must marry and produce to this extent, or else, fewer marrying, those few must have families exceeding on the average four children, in exact proportion to the rate of abstention. And if the community is to increase (which on Darwinian principles I believe to be a condition precedent of national health and vigor), then either all adults must marry and produce more than four children apiece, or else, fewer marrying, those few must produce as many more as will compensate for the abstention of the remainder and form a small surplus in each generation.

In Britain, at the present day, I believe I am right in deducing (after Mr. F. Galton) that an average of about six children per marriage (not per head of female inhabitants) is necessary in order to keep the population just stationary. And the actual number of children per marriage is a little in excess of even that high

figure, thus providing for the regular increase from census to census and for overflow by emigration.

These facts, all platitudes as they are, look so startling at first sight that they will probably need for the unstatistical reader a little explanation and simplification.

Well, suppose, now, every man and every woman in a given community were to marry; and suppose they were in each case to produce two children, a boy and a girl; and suppose those children were in every case to attain maturity; why, then, the next generation would exactly reproduce the last, each father being represented by his son, and each mother by her daughter, *ad infinitum*. (I purposely omit, for simplicity's sake, the complicating factor of the length and succession of generations, which by good luck in the case of the human species practically cancels itself.) But, as a matter of fact, all the children do not attain maturity: on the contrary, nearly half of them die before reaching the age of manhood—in some conditions of life, indeed, and in some countries, more than half. Roughly speaking, therefore (for I don't wish to become a statistical bore), it may be said that in order that two children may attain maturity and be capable of marriage, even under the most favorable circumstances, four must be born. The other two must be provided to cover risks of infant or adolescent mortality, and to insure against infertility or incapacity for marriage in later life. They are wanted to make up the categories of soldiers, sailors, imbeciles, cripples, and incapables generally. So that even if every possible person married, and if every married pair had four children, we should only just keep up the number of our population from one age to another.

Now, I need hardly say that not every possible person does marry, and that we do actually a good deal more than keep up the number of our population. Therefore it will at once be clear that each actual marriage is fertile to considerably more than the extent of four children. That is, indeed, a heavy burden to lay upon women. One aim, at least, of social reformers should certainly be to lighten it as much as possible.

Nevertheless, I think, it will be abundantly apparent from these simple considerations that in every community, and to all time, the vast majority of the women must become wives and mothers, and must bear at least four children apiece. If some women shirk their natural duties, then a heavier task must be laid upon the remainder. But in any case almost all must become wives and mothers, and almost all must bear at least four or five children. In our existing state six are the very fewest that our country can do with.

Moreover, it is pretty clear that the best ordered community will be one where as large a proportion of the women as possible

marry, and where the burden of maternity is thus most evenly shared between them.* Admitting that certain women may have good reasons for avoiding maternity on various grounds—unfitness, or, what is probably much the same thing at bottom, disinclination—and admitting also that where such good reasons exist, it is best those women should remain unmarried, we must still feel that in most cases marriage is in itself desirable, and that limited families are better than large ones. In other words, it is best for the community at large that most women should marry, and should have moderate families, rather than that fewer should marry and have unwieldily large ones; for if families are moderate there will be a greater reserve of health and strength left in the mothers for each birth, the production of children can be spread more slowly over a longer time, and the family resources will be less heavily taxed for their maintenance and education. Incidentally this will benefit both parents as well as the community. That is to say, where many marriages and small families are the rule, the children will on the average be born healthier, be better fed, and be launched more fairly on the world in the end. Where marriages are fewer and families large, the strain of maternity will be most constant and most heavily felt; the father will be harder worked, and the children will be born feebler, will be worse fed, and will start worse equipped in the battle of life.

Hence I would infer that the goal a wise community should keep in view is rather more marriages and fewer children per marriage, than fewer marriages and more children per marriage.

Or, to put these conclusions another way: in any case, the vast majority of women in any community must needs become wives and mothers; and in the best ordered community the largest possible number will doubtless become so, in order to distribute the burden equally, and to produce in the end the best results for the nation.

Well, it may be brutal and unmanly to admit these facts or to insist upon these facts, as we are often told it is by maiden ladies; but still, if we are to go on existing at all, we must look the facts fairly and squarely in the face, and must see how modern tendencies stand with regard to them.

Now, I have the greatest sympathy with the modern woman's demand for emancipation. I am an enthusiast on the Woman Question. Indeed, so far am I from wishing to keep her in subjection to man, that I should like to see her a great deal more emancipated than she herself as yet at all desires. Only, her emancipation must not be of a sort that interferes in any way with

*Oh, yes, I know all about Malthus; but Mr. Galton has shown that a certain amount of over-population is necessary for survival of the fittest, and that if the best and most intelligent classes abstain, the worst and lowest will surely make up the leeway for them.

this prime natural necessity. To the end of all time, it is mathematically demonstrable that most women must become the mothers of at least four children, or else the race must cease to exist. Any supposed solution of the woman problem, therefore, which fails to look this fact straight in the face, is a false solution. It cries "Peace, peace!" where there is no peace. It substitutes a verbal juggle for a real way out of the difficulty. It withdraws the attention of thinking women from the true problem of their sex to fix it on side-issues of comparative unimportance.

And this, I believe, is what almost all the Woman's Rights women are sedulously doing at the present day. They are pursuing a chimera, and neglecting to perceive the true aim of their sex. They are setting up a false and unattainable ideal, while they omit to realize the true and attainable one which alone is open to them.

For let us look again for a moment at what this all but universal necessity of maternity implies. Almost every woman must bear four or five children. In doing so she must on the average use up the ten or twelve best years of her life—the ten or twelve years that immediately succeed her attainment of complete womanhood. For note, by the way, that these women must also for the most part marry young: as Mr. Galton has shown, you can quietly and effectually wipe out a race by merely making its women all marry at twenty-eight: married beyond that age, they don't produce children enough to replenish the population. Again, during these ten or twelve years of child-bearing at the very least, the women can't conveniently earn their own livelihood; they must be provided for by the labor of the men—under existing circumstances (in favor of which I have no Philistine prejudice) by their own husbands. It is true that in the very lowest state of savagery special provision is seldom made by the men for the women even during the periods of pregnancy, childbirth, and infancy of the offspring. The women must live (as among the Hottentots) over the worst of these periods on their own stored-up stock of fat, like hibernating bears or desert camels. It is true also that among savage races generally the women have to work as hard as the men, though the men bear in most cases the larger share in providing actual food for the entire family. But in civilized communities—and the more so in proportion to their degree of civilization—the men do most of the hardest work, and in particular take upon themselves the duty of providing for the wives and children. The higher the type, the longer are the wives and children provided for. Analogy would lead one to suppose (with Comte) that in the highest communities the men would do all the work, and the women would be left entirely free to undertake the management and education of the children.

Seeing, then, that these necessities are laid by the very nature of our organization upon women, it would appear as though two duties were clearly imposed upon the women themselves, and upon all those men who sympathize in their welfare: First, to see that their training and education should fit them above everything else for this their main function in life; and, second, that in consideration of the special burden they have to bear in connection with reproduction, all the rest of life should be made as light and easy and free for them as possible. We ought frankly to recognize that most women must be wives and mothers; that most women should therefore be trained, physically, morally, socially, and mentally, in the way best fitting them to be wives and mothers; and that all such women have a right to the fullest and most generous support in carrying out their functions as wives and mothers.

And here it is that we seem to come in conflict for a moment with most of the modern Woman-Question agitators. I say for a moment only, for I am not going to admit, even for that brief space of time, that the doctrine I wish to set forth here is one whit less advanced, one whit less radical, or one whit less emancipatory than the doctrine laid down by the most emancipated women. On the contrary, I feel sure that while women are crying for emancipation they really want to be left in slavery; and that it is only a few exceptional men, here and there in the world, who wish to see them fully and wholly enfranchised. And those men are not the ones who take the lead in so-called Woman's Rights movements.

For what is the ideal that most of these modern women agitators set before them? Is it not clearly the ideal of an unsexed woman? Are they not always talking to us as though it were not the fact that most women must be wives and mothers? Do they not treat any reference to that fact as something ungenerous, ungentlemanly, and almost brutal? Do they not talk about our "casting their sex in their teeth"?—as though any man ever resented the imputation of manliness. Nay, have we not even, many times lately, heard those women who insist upon the essential womanliness of women described as "traitors to the cause of their sex"? Now, we men are (rightly) very jealous of our virility. We hold it a slight not to be borne that any one should impugn our essential manhood. And we do well to be angry; for virility is the key-note to all that is best and most forcible in the masculine character. Women ought equally to glory in their femininity. A woman ought to be ashamed to say she has no desire to become a wife and mother. Many such women there are, no doubt—it is to be feared, with our existing training, far too many; but, instead of boasting of their sexlessness as a matter of

pride, they ought to keep it dark, and to be ashamed of it—as ashamed as a man in a like predicament would be of his impotence. They ought to feel they have fallen short of the healthy instincts of their kind, instead of posing as in some sense the cream of the universe, on the strength of what is really a functional aberration.

Unfortunately, however, just at the present moment, a considerable number of the ablest women have been misled into taking this unfeminine side, and becoming real "traitors to their sex" in so far as they endeavor to assimilate women to men in everything, and to put upon their shoulders, as a glory and privilege, the burden of their own support. Unfortunately, too, they have erected into an ideal what is really an unhappy necessity of the passing phase. They have set before them as an aim what ought to be regarded as a *pis-aller*. And the reasons why they have done so are abundantly evident to anybody who takes a wide and extended view of the present crisis—for a crisis it undoubtedly is—in the position of women.

In the first place, the movement for the higher education of women, in itself an excellent and most praiseworthy movement, has at first, almost of necessity, taken a wrong direction, which has entailed in the end much of the present uneasiness. Of course, nothing could well be worse than the so-called education of women forty or fifty years ago. Of course, nothing could be narrower than the view of their sex then prevalent, as eternally predestined to suckle fools and chronicle small beer. But when the need for some change was first felt, instead of reform taking a rational direction—instead of women being educated to suckle strong and intelligent children, and to order well a wholesome, beautiful, reasonable household—the mistake was made of educating them like men—giving a like training for totally unlike functions. The result was that many women became unsexed in the process, and many others acquired a distaste, an unnatural distaste, for the functions which Nature intended them to perform. At the present moment a great majority of the ablest women are wholly dissatisfied with their own position as women, and with the position imposed by the facts of the case upon women generally; and this as the direct result of their false education. They have no real plan to propose for the future of women as a sex; but in a vague and formless way they protest inarticulately against the whole feminine function in women, often even going the length of talking as though the world could get along permanently without wives and mothers.*

* A short time ago I received an angry letter from a correspondent in Iowa, full of curious bluster about "doing without the men altogether." Apparently this lady really imagined that the human race could be recruited from the gooseberry bushes.

In the second place, a certain real lack of men to marry, here and now, in certain classes of society, and those the classes that lead thought, has made an exceptional number of able women at present husbandless, and thus has added strength to the feeling that women must and ought to earn their own living. How small and local this cause is I shall hereafter try to show: but there can be no doubt that it has much to do with the present discontents among women. There is a feeling abroad that many women can't get married; and this feeling, bolstered up by erroneous statistics and misunderstood facts, has greatly induced women to erect into an ideal for all what is really a *pis-aller* for a small fraction of their body—self-support in competition with men.

But are there not seven hundred thousand more women than men in the United Kingdom? And must not these seven hundred thousand be enabled to earn their own living? That is the one solid fact which the "advanced" women are always flinging at our heads; and that is the one fallacious bit of statistics which seems at first sight to give some color of reasonableness to the arguments in favor of the defeminization of women.

As a matter of fact, the statistics are not true. There are not seven hundred thousand more women than men, but seven hundred thousand more *females* than *males* in the United Kingdom. The people who say "seven hundred thousand women," picture to themselves that vast body of marriageable girls, massed in a hollow square, and looking about them in vain, across wide leagues of country, for non-existent husbands. But figures are things that always require to be explained, and, above all, to be regarded in their true proportions to one another. These seven hundred thousand females include infants in arms, lunatics, sisters of charity, unfortunates, and ladies of eighty. A large part of the excess is due to the greater longevity of women; and the number comprises the great mass of widows, who have once in their lives possessed a husband of their own, and have outlived him, partly because they are, as a rule, younger, and partly by dint of their stronger constitutions. Moreover, this total disparity of seven hundred thousand, including babies, lunatics, and widows, is a disparity on a gross population of something more than thirty-five millions. Looking these figures straight in the face, we find the actual proportion of the sexes to be as 172 males to 179 females. Speaking very roughly, this makes about four females in every hundred, including babies, widows, and so forth, who have not a complementary male found for them. This in itself is surely no very terrible disproportion. It does not more than cover the relative number of women who are naturally debarred from marriage, or who under no circumstances would ever submit to be married. Out of every hundred women, roughly speaking, ninety-six have

husbands provided for them by nature, and only four need go into a nunnery or take to teaching the higher mathematics. And if the marriageable men and women only are reckoned in the account, as far as I can gather from existing statistics, the disproportion sinks to a quite insignificant fraction.

Nevertheless, it is a fact, that both in England and America the marriageable men of the middle and upper classes are not to the fore, and that accordingly in these classes—the discussing, thinking, agitating classes—an undue proportion of women remains unmarried. The causes of this class disparity are not far to seek. In America the young man has gone West. In England he is in the army, in the navy, in the Indian Civil Service, in the Cape Mounted Rifles. He is sheep-farming in New Zealand, ranching in Colorado, growing tea in Assam, planting coffee in Ceylon; he is a cowboy in Montana, or a wheat-farmer in Manitoba, or a diamond-digger at Kimberley, or a merchant at Melbourne: in short, he is anywhere and everywhere except where he ought to be, making love to the pretty girls in England. For, being a man, I, of course, take it for granted that the first business of a girl is to be pretty.

Owing to these causes, it has unfortunately happened that a period of great upheaval in the female mind has coincided with a period when the number of unmarried women in the cultivated classes was abnormally large. The upheaval would undoubtedly have taken place in our time, even without the co-operation of this last exacerbating cause. The position of women was not a position which could bear the test of nineteenth-century scrutiny. Their education was inadequate; their social status was humiliating; their political power was *nil*; their practical and personal grievances were innumerable: above all, their relation to the family—to their husbands, their children, their friends, their property—was simply insupportable. A real Woman Question there was, and is, and must be. The pity of it is that the coincidence of its recognition with the dearth of marriageable men in the middle and upper classes has largely deflected the consequent movement into wrong and essentially impracticable channels.

For the result has been that, instead of subordinating the claims of the unmarried women to the claims of the wives and mothers, the movement has subordinated the claims of the wives and mothers to the claims of the unmarried women. Almost all the Woman's Rights women have constantly spoken, thought, and written as though it were possible and desirable for the mass of women to support themselves, and to remain unmarried forever. The point of view they all tacitly take is the point of view of the self-supporting spinster. Now, the self-supporting spinster

is undoubtedly a fact—a deplorable accident of the passing moment. Probably, however, even the most rabid of the Woman's Rights people would admit, if hard pressed, that in the best-ordered community almost every woman should marry at twenty or thereabouts. We ought, of course, frankly to recognize the existence of the deplorable accident; we ought for the moment to make things as easy and smooth as possible for her; we ought to remove all professional barriers, to break down the absurd jealousies and prejudices of men, to give her fair play, and if possible a little more than fair play, in the struggle for existence. So much our very chivalry ought to make obligatory upon us. That we should try to handicap her heavily in the race for life is a shame to our manhood. But we ought at the same time fully to realize that she is an abnormity, not the woman of the future. We ought not to erect into an ideal what is in reality a painful necessity of the present transitional age. We ought always clearly to bear in mind—men and women alike—that to all time the vast majority of women must be wives and mothers; that on those women who become wives and mothers depends the future of the race; and that, if either class must be sacrificed to the other, it is the spinsters whose type perishes with them that should be sacrificed to the matrons who carry on the life and qualities of the species.

For this reason a scheme of female education ought to be mainly a scheme for the education of wives and mothers. And if women realized how noble and important a task it is that falls upon mothers, they would ask no other. If they realized how magnificent a nation might be molded by mothers who devoted themselves faithfully and earnestly to their great privilege, they would be proud to carry out the duties of their maternity. Instead of that, the scheme of female education now in vogue is a scheme for the production of literary women, schoolmistresses, hospital nurses, and lecturers on cookery. All these things are good in themselves, to be sure—I have not a word to say against them; but they are not of the center. They are side-lines off the main stream of feminine life, which must always consist of the maternal element. "But we can't know beforehand," say the advocates of the mannish training, "which women are going to be married, and which to be spinsters." Exactly so; and therefore you sacrifice the many to the few, the potential wives to the possible lady lecturers. You sacrifice the race to a handful of barren experimenters. What is thus true of the blind groping after female education is true throughout of almost all the Woman Movement. It gives precedence to the wrong element in the problem. What is essential and eternal it neglects in favor of what is accidental and temporary. What is feminine in

women it neglects in favor of what is masculine. It attempts to override the natural distinction of the sexes, and to make women men—in all but virility.

The exact opposite, I believe, is the true line of progress. We are of two sexes: and in healthy diversity of sex, pushed to its utmost, lies the greatest strength of all of us. Make your men virile: make your women womanly. Don't cramp their intelligence: don't compress their waists: don't try to turn them into dolls or dancing girls: but freely and equally develop their feminine idiosyncrasy, physical, moral, intellectual. Let them be healthy in body: let them be sound in mind: if possible (but here I know even the most advanced among them will object), try to preserve them from the tyranny of their own chosen goddess and model, Mrs. Grundy. In one word, emancipate woman (if woman will let you, which is more than doubtful), but leave her woman still, not a dulled and spiritless epicene automaton.

That last, it is to be feared, is the one existing practical result of the higher education of women, up to date. Both in England and America, the women of the cultivated classes are becoming unfit to be wives or mothers. Their sexuality (which lies at the basis of everything) is enfeebled or destroyed. In some cases they eschew marriage altogether—openly refuse and despise it, which surely shows a lamentable weakening of wholesome feminine instincts. In other cases, they marry, though obviously ill adapted to bear the strain of maternity; and in such instances they frequently break down with the birth of their first or second infant. This evil, of course, is destined by natural means to cure itself with time: the families in question will not be represented at all in the second generation, or will be represented only by feeble and futile descendants. In a hundred years, things will have righted themselves; but meanwhile there is a danger that many of the most cultivated and able families of the English-speaking race will have become extinct, through the prime error of supposing that an education which is good for men must necessarily also be good for women.

I said just now that many women at present eschew marriage, and that this shows a weakening of wholesome feminine instinct. Let me hasten to add, for fear of misconception—I mean, of course, if they eschew it for want of the physical impulse which ought to be as present in every healthy woman as in every healthy man. That independent-minded women should hesitate to accept the terms of marriage as they now and here exist, I do not wonder. But if they have it really at heart to alter those terms, to escape from slavery, to widen the basis of the contract between the sexes, to put the wife on a higher and safer footing, most sensible men, I feel sure, will heartily co-operate with them. As a rule, how-

ever, I observe in actual life that "advanced" women are chary of either putting forward or accepting modifications in this matter. They dread the frown of their Grundian deity. They usually content themselves with vague declamation and with erecting female celibacy into a panacea for the ills that woman is heir to, while they refuse to meddle at all in definite terms with the question of marriage or its substitute in the future. While denouncing loudly the supremacy of man, they seem ready to shake off that supremacy only for the celibate minority of their sex, without attempting to do anything for the married majority.

To sum up the point whither this long, and I confess discursive, argument is tending. There is, and ought to be, a genuine Woman Question and a genuine Woman Movement. But that movement, if it is ever to do any good, must not ignore—nay, on the contrary, must frankly and unreservedly accept and embrace—the fact that the vast majority of adult women are and will always be wives and mothers (and when I say "wives," I say so only in the broadest sense, subject to all possible expansions or modifications of the nature of wifehood). It must also recognize the other fact that in an ideal community the greatest possible number of women should be devoted to the duties of maternity, in order that the average family may be kept small, that is to say, healthy and educable. It must assume as its goal, not general celibacy and the independence of women, but general marriage and the ample support of women by the men of the community. While allowing that exceptional circumstances call for exceptional tenderness toward those women who are now compelled by untoward conditions to earn their own livelihood, it will avoid creating that accident into a positive goal, and it will endeavor to lessen the necessity for the existence of such exceptions in the future. In short, it will recognize maternity as the central function of the mass of women, and will do everything in its power to make that maternity as healthy, as noble, and as little burdensome as possible.

If the "advanced" women will meet us on this platform, I believe the majority of "advanced" men will gladly hold out to them the right hand of fellowship. As a body we are, I think, prepared to reconsider, and to reconsider fundamentally, without prejudice or preconception, the entire question of the relations between the sexes—which is a great deal more than the women are prepared to do. We are ready to make any modifications in those relations which will satisfy the woman's just aspiration for personal independence, for intellectual and moral development, for physical culture, for political activity, and for a voice in the arrangement of her own affairs, both domestic and national. As a matter of fact, few women will go as far in their desire to eman-

cipate woman as many men will go. It was Ibsen, not Mrs. Ibsen, who wrote the "Doll's House." It was women, not men, who ostracized George Eliot. The slavishness begotten in women by the *régime* of man is what we have most to fight against, not the slave-driving instinct of the men—now happily becoming obsolete, or even changing into a sincere desire to do equal justice. But what we must absolutely insist upon is full and free recognition of the fact that, in spite of everything, the race and the nation must go on reproducing themselves. Whatever modifications we make must not interfere with that prime necessity. We will not aid or abet women as a sex in rebelling against maternity, or in quarreling with the constitution of the solar system. Whether we have wives or not—and that is a minor point about which I, for one, am supremely unprejudiced—we must at least have mothers. And it would be well, if possible, to bring up those mothers as strong, as wise, as free, as sane, as healthy, as earnest, and as efficient as we can make them. If this is barren paradox, I am content to be paradoxical; if this is rank Toryism, I am content for once to be reckoned among the Tories.—*Fortnightly Review.*

NEW PHASES IN THE CHINESE PROBLEM.

By WILLARD B. FARWELL.

THE whirligig of politics, rather than that of time, undoubtedly brought about the hasty passage by Congress of the so-called "Chinese Exclusion Act." Being simply "a supplement" to the act of May 6, 1882, which expires by its own limitation on the 6th of May, 1892, it can of course only be regarded as a temporary measure; and unless other legislation of like character, but more well considered and permanent in its operation, is had before May 6, 1892, the country will then be as open to the free and unrestricted immigration of the Chinese as it was prior to the treaty of 1881, and the act to execute its provisions to which this is a supplement. The passage of this measure by Congress, and its approval by the President, suggest new phases in the Chinese problem. First among them all is, Will exclusion exclude, as provided in the machinery of this act? To find an intelligent answer to this question, it is necessary first to understand the causes and motives which impel the Chinese to migrate from their native country. Until this phase of the question is fairly presented, the difficulties involved in excluding the Chinese by legislative methods will not be rightly estimated by Congress or by the country at large.

With an area of 1,297,999 square miles, China possessed a pop-

ulation in 1882, according to the best accepted authorities, of 380,000,000, or a fraction less than 300 people to the square mile. This average, large as it is, gives no adequate idea of the real density of the population in the nine important provinces of China. In 1812 the Chinese census gave 850, 705, and 671 inhabitants to the square mile in the three provinces of Kiangsu, Nganhwsu, and Chehkiang respectively. These averages have since increased largely, but there are no reliable data from which to give the present population per square mile in these or other provinces. The struggle for life under such conditions of overpopulation must necessarily be severe beyond description. But when we add to this the fluctuations of rainfall, involving frequently occurring periods of drought and flood, and consequent famine and misery, we begin to perceive the true causes of Chinese emigration.

The famine of 1878, growing out of the drought of the four preceding years, it is estimated, swept from nine and one half to thirteen millions of inhabitants out of existence. "At all epochs," says the Abbé Huc, "and in the most flourishing and best-governed countries, there always have been, and there always will be, poor; but unquestionably there can be found in no other country such a depth of disastrous poverty as in the Chinese Empire. Not a year passes in which a terrific number of persons do not perish of famine in some part of China, and the number of those who live merely from day to day is incalculable. Let a drought, an inundation, or any accident whatever occur to injure the harvest in a single province, and two thirds of the population are immediately reduced to a state of starvation. You see them forming themselves into numerous bands—perfect armies of beggars—and proceeding together, men, women, and children, to seek in the towns and villages for some little nourishment wherewith to sustain for a brief interval their miserable existence. Many fall down by the wayside and die before they can reach the place where they had hoped to find help. You see their bodies lying in the fields and at the road-side, and you pass without taking much notice of them, so familiar is the horrid spectacle."

"Calamities of this kind occur every year in some place or other; and those who have made any savings are able to get through the crisis and wait for better days; but others, who are always in much greater numbers, have no choice but to expatriate themselves or die of famine."

In 1855 Sir John Bowring, the "British Resident at Canton," in reply to inquiries from the Registrar-General in London, gave some interesting facts concerning the Chinese, which were subsequently published by the Statistical Society. Speaking of the emigration from China, he said:

"The constant flow of emigration from China, contrasted with

the complete absence of immigration into China, is striking evidence of the redundancy of the population; for, though that emigration is almost wholly confined to two provinces, viz., Kwangtung and Fookien, representing together a population of probably from 34,000,000 to 35,000,000, I am disposed to think that a number nearer 3,000,000 than 2,000,000 from these provinces alone are located in foreign countries. In the kingdom of Siam it is estimated that there are at least 1,500,000 Chinese, of which 200,000 are in the capital (Bankok). They crowd all the islands of the Indian Archipelago. In Java, we know by correct census there are 136,000. Cochin-China teems with Chinese. In this colony we are seldom without one, two, or three vessels taking Chinese emigrants to California and other places. Multitudes go to Australia, to the Philippines, to the Sandwich Islands, to the western coast of Central and Southern America; some have made their way to British India. The emigration to the British West Indies has been considerable, to the Havanna greater still. The annual arrivals in Singapore are estimated at an average of 10,000, and 2,000 is the number that are said annually to return to China."

"There is not only this enormous maritime emigration, but a considerable inland efflux of Chinese toward Manchuria and Thibet; and it may be added that the large and fertile islands of Formosa and Hainan have been to a great extent won from the aborigines by successive inroads of Chinese settlers. Now these are all males; there is not a woman to 10,000 men; hence, perhaps, the small social value of the female infant. Yet the perpetual outflowing of people seems in no respect to diminish the number of those who are left behind."

Sir John Bowring not only testifies to this perpetual outflow of Chinese emigrants, but he paints in vivid colors the causes which lead to these results. He says: "There is probably no part of the world in which the harvests of mortality are more sweeping and destructive than in China, producing voids which require no ordinary appliances to fill up. Multitudes perish absolutely from want of the means of existence; inundations destroy towns and villages, and all their inhabitants; it would not be easy to calculate the loss of life by the typhoons and hurricanes which visit the coasts of China, in which boats and junks are sometimes sacrificed by hundreds and by thousands. The late civil wars in China must have led to the loss of millions of lives. The sacrifices of human beings by executions alone are frightful."

It is such a condition of things, and such causes as these, that induce the laboring classes of Chinese to emigrate to other countries. Considering the incentive which exists in these densely populated districts to escape from the misery which marks their existence, and to seek new lands where their condition may be

bettered, the dangers that threaten from such inexhaustible sources of human supply become easy of appreciation.

It may well be inferred that a line of public policy on the part of any other nation intended to shut out such a class of immigration as this must be literally "iron-clad" in its construction, and must involve measures of defense practically as stern, unrelenting, and costly in their character as are the measures of defense against invasion commonly taken among nations at war with each other.

So far, Chinese immigration in other countries has been sufficiently powerful to break down all the barriers that have been reared against it. Wherever they have gained a foothold there they have continued to go, there they have increased and multiplied. Wherever they have gone, in earlier or later times, prolonged contact with them and competition in the field of labor have developed the same race antipathies that exist between the American people on the Pacific coast and the Chinese to-day.

Since 1860 200,000 Chinese have landed in Chili and Peru. Nearly 400,000 have found their way into the United States through the port of San Francisco since the Chinese immigration first began. The numbers that have migrated to Australia, the Sandwich Islands, and other countries have been enormous. The larger part of this emigration from China has occurred since the walls of Chinese exclusiveness were battered down by English and French cannon in 1858. It is clear that, while China was then opened to the commerce and intercourse of the world, so the world was likewise opened to the free flow of the yellow tide of Chinese immigration, sweeping with constantly augmented and resistless force in every direction. We have seen the incentive of poverty and misery at home that underlies and induces Chinese emigration. We have seen that with them it is either expatriation or starvation. We have seen that massacre and cruelty can not change their purpose or intimidate them, and we may well ask ourselves the question whether the mild type of legislation embodied in the "Scott Exclusion Act" can be more effective in this direction. Assuming that it will be sustained by the Supreme Court of the United States, assuming that it will effectually stop the landing of Chinese in our ports, how far will it prove effective in barring the entrance of Chinese along the thousands of miles of frontier that intervene between British Columbia on the north and Mexico on the south? Is it to be presumed that Chinese cunning and perseverance, inspired by their wretched condition at home, and the incentive of good wages, constant employment, and a more comfortable mode of life here, will not overcome all obstacles that this hasty and crude kind of legislation has set up against them? Is it to be presumed that a law that imposes upon

them no penalty other than that of being sent back if they are detected, will keep them out, when the fear of death has been found wholly ineffective to do so? Will exclusion exclude under such conditions as these? Moreover, can any law ever be enacted by an American Congress that would not shock the Christian world by the inhumanity of its penalties, that will ever be effective in excluding them from our soil? For violations of State and municipal laws the jails and prisons have been crowded with Chinese for months and years, and all to no purpose. The constant perpetration of the same offenses manifests but too plainly the utter inutility of dealing with the Chinese by any such methods as these.

The race that is reared under the fear of the "cangue," the "bastinado," and limb and bodily torture of hideous ingenuity as punishments for trivial offenses, can not be restrained or terrorized by prison penalties as ordinarily provided under American laws. Much less can they be prevented from attempting to gain entrance into the country by the mere fear of being sent back if detected. And it may well be believed that thousands upon thousands would still continue the attempt, in willing exchange for free board and lodging in a well-kept American prison, with hard labor, were that penalty made to attach to the act.

Under such circumstances as these, will exclusion exclude, in the way and manner provided in the "Scott Exclusion Act"? More than this, can any remedy for Chinese immigration be devised that does not look to the stationing of an army of thousands of men along our northern and southern borders, and at a cost bordering upon the permanent prosecution of a defensive war, except by treaty co-operation on the part of the British provinces on the north and Mexico on the south?

The inefficiency of this hasty political measure of exclusion is only equaled by the public disgrace involved in the manner of its inception and enactment, which the most radical believer in the policy of Chinese exclusion can not fail to admit constitutes the most shameful page in American history.

If we are to assume that this or any other legislation that may be had by Congress *can* be made to result in effectual Chinese exclusion, the problems that present themselves for consideration are hardly less interesting and deserving of study than if this class of immigration were to be tolerated indefinitely. Already there are probably more than 200,000 Chinese upon American soil. In mode of life, costume, religion, clannishness, social vices, and language, they may be said to have evinced no perceptible change during the forty years that have elapsed since they found lodgment here. Had they, during all this period, remained in the heart of the Chinese Empire, they could not have been more in-

tensely Chinese in all respects than they are to-day with all their experience of contact with American civilization. True, they have been the gainers to the extent of the knowledge and skill they have acquired in the field of skilled labor and the use of machinery, but it has made no impression upon their race-habits and instanced no sign of assimilation with the race which surrounds them.

We are accustomed to regard our own ethnological stock as the dominant race of mankind; and yet, wherever the Chinese have colonized among us, we have yielded the ground before their advancing hosts, and have surrendered to them a dominance in law, social habits, and religion. While all other races which combine to form the American people proper yield common obedience to the laws, and may be regarded as a common brotherhood in social and political citizenship, the Chinese have remained a law unto themselves, and in the estimation of the Christian communities in which they have established themselves they are the same unchanged and unchangeable heathen race that they were when they landed upon our shores. Such have been the results of nearly forty years of contact of the two races. If we consider this period too short a time in which to look for contrary results, what shall we say of the fact—for fact it is—that in the Philippine Islands, where the Chinese have been colonized now for nearly three hundred years, precisely the same results have come about—no better and no worse? Not only have they maintained their race characteristics, but in every instance they have proved themselves to be the stronger, in so far as the acquisition of material wealth and advantage are concerned, maintaining all the while their religion against all efforts at conversion.

"In 1871," says the Baron von Hübner, "the entire English trade with China, amounting to £42,000,000 sterling, was transacted through English firms." Since that time, he adds that, "with the exception of some great influential English firms, all the same trade has passed into the hands of Chinese merchants." In Macao similar results have obtained.

When the Manchus conquered China, they swept all before them and introduced Manchu habits and customs. But steadily these innovations gave way to Chinese influences. "You may now," says the Abbé Huc, "traverse Manchuria to the river Amoor without being at all aware that you are not traveling in a province of China. The local coloring has been totally effaced. The Manchu Tartars have almost totally abdicated their own manners, and adopted instead those of the Chinese."

Has Chinese colonization in San Francisco shown any different results? Let us see. That portion of San Francisco known to-day as Chinatown was originally the residence and business cen-

ter of the town. Its natural advantages made it the choice of the early American settlers, and as such it would doubtless have remained to-day had it not been for the advent of the Chinese. These latter, seeing also its advantages, located themselves there. As they increased in numbers, Christian civilization with instinctive repugnance retreated before them, until, within this entire district, once literally San Francisco itself, there is not a vestige of American civilization remaining save in the abandoned homes, churches, and other private and public buildings, each one of which fairly swarms with hordes of unclean and unsavory Chinese. A missionary writer, the Rev. Mr. Gibson, an advocate of Chinese immigration for Christianizing purposes, tells the story in his book, "The Chinese in America," of the abandonment of the "First Baptist Church" in San Francisco to the Chinese:

"What was lately the First Baptist Church of San Francisco is now a crowded Chinese tenement-house, full of all manner of filthiness, shame, and sin. Where but lately was the altar of the living God, now smokes the incense of idolatry. That sacred temple, where once the voice of prayer and praise to God was heard. now echoes with idolatrous chants and bacchanalian songs. Instead of standing firm against the incoming hosts of idolatry and sin, the Church of Christ has beaten an ignominious retreat, has surrendered without a struggle one of the strongest fortifications and retreated in disorder before the advancing hosts of idolatry." Thus, here as elsewhere, they have established their supremacy, defied all laws for their government and the suppression of their vices, and erected themselves into an *imperium in imperio,* conquering and still to conquer.

If the further coming of this race be successfully prevented, it will probably be contended that, among the new generations which are to be born here, and which will be entitled to all the rights and privileges of American citizenship by reason of that fact, the influences of Christian civilization will be so powerful as to obliterate race habits and vices, and substitute those of our own race for their own. There has been no test of this under these special conditions, and therefore there can be nothing foretold with precision in regard to it. We can not lose sight of the fact, however, that the children born of Chinese parents in San Francisco so far are as distinctly Chinese in race, habits, superstitions, vices, and costume as were their fathers before them. Thus far there has not been a perceptible change in them. As in every other country where they have colonized the same results have followed, why should we look for different results here? It will be said that they are quick to learn, and capable of excelling in all classes of skilled labor, and therefore they should be equally responsive in exchanging their race habits and civilization for our own. How-

ever plausible such a theory may sound, forty years' experience in San Francisco testifies to the contrary. A people of traditions, the lives, work, and history of whose generations are and always have been but a repetition of each other, they seem incapable of change except in the acquisition of such mechanical skill and knowledge as can be made subservient to their material advantage.

The successful exclusion of further Chinese immigration, and thereby the complete isolation of the Chinese who are among us from their countrymen at home, will certainly offer a more favorable field for Christian missionary work than has heretofore existed. But that which has been accomplished thus far certainly does not inspire confidence that much is to be gained in that direction. Mr. Gibson, the most prominent of all missionary workers among the Chinese in California, testified in 1876 to the effect that, out of one hundred and fifty thousand Chinese in California, but two hundred and seventy-one had, up to that date, been baptized and received into Christian church communion. And he failed entirely to note how many of these had fallen from grace, and gone back to their original faith and practices. He failed also to give the simple truth to the world that, for every "soul so hopefully converted and saved"—to use his own words—thousands of young men had been ruined by the presence of the Chinese through the introduction and spread of the opium habit, the dissemination of hereditary disease through their innumerable dens of prostitution, the destructive influences of their lottery and gambling dens, and the general demoralization of the field of labor.

Is there not something that always has and always will successfully resist efforts at Christianization of the Chinese? Let us resort again to the testimony of that devout and earnest missionary, the Abbé Huc, than whom no one has ever written more clearly and truthfully of the habits and characteristics of the race:

"In the five ports open to Europeans, religious liberty really does exist, and it is protected by the presence of consuls and ships of war. Yet the number of Christians does not increase more rapidly than in the interior of the empire. In Macao, Hong-Kong, Manila, Singapore, Penang, Batavia, though they are under the dominion of Europeans, the great mass of the population consists of Chinese, who for the most part are permanently settled in these cities, and hold in their hands the great interests of agriculture, commerce, and industry. It is certainly not the fault of persecution of the European authorities that hinders them from embracing Christianity. Yet the conversions are not more numerous than elsewhere. . . .

"The Chinese are so completely absorbed in temporal interests,

in the things that fall under their senses, that their whole life is only materialism put in action. . . .

"Lucre is the sole object on which their eyes are constantly fixed. . . . A burning thirst to realize some profit, great or small, absorbs their faculties, the whole energy of their being. They never pursue anything with ardor but riches and natural enjoyments. God, the soul, a future life, they believe in none of them, or rather they never think about them at all."*

The Chinese maxim is "*Pon-toun-kiao*" ("Religions are many, reason is one: we are all brothers"). This phrase is on the lips of every Chinese, and they bandy it from one to the other with the most exquisite urbanity. It is indeed a clear and concise expression of their feelings on religious questions. In their eyes, a worship is merely an affair of taste and fashion, to which no more importance is attached than to the color of garments.

Let it not be forgotten that we are dealing with a race which holds among other singular tenets the abhorrent doctrine that woman plays no other part in nature than as an indispensable necessity for the propagation of mankind; that she has no soul, but is merely a necessary animal adjunct in the human race, serviceable for its perpetuation, for the gratification of the animal passions of men, for the common drudgery of the household or field labor, but not worthy of education and not eligible to salvation as taught by any scheme of future existence within their belief or knowledge. Let us make no mistake about this. It is in proof in the writings of Chinese missionaries and travelers of every nationality. It is the one point on which they all agree. It is the belief and teaching upon which the practice of infanticide prevails in China, in which the female child is invariably the victim and

* Since the foregoing was written, Canon Taylor, of the English Established Church, in an article in the "Fortnightly Review," entitled "The Great Missionary Failure," furnishes the following interesting statistical information: "China is perhaps the most disheartening case. The population is reckoned at 382,000,000. The annual increase by the excess of births over deaths would be about 4,580,000. Last year the Church Missionary Society baptized 167 adults. At this rate it would take the Church Missionary Society 27,000 years to overtake the gain to heathenism in a single year! If the population were stationary, it would take more than 1,680,000 years to convert the Chinese Empire. If the progress is slow, the expenditure is lavish. Last year in Ceylon 424 agents of the Church Missionary Society spent £11,003 16*s.* 7*d.* in making 190 adult converts out of a population of nearly three millions, but the relapses were more numerous than the converts, as there was a decrease of 143 in the native Christian adherents. In China 247 agents of the same society spent £14,875 3*s.* in making 167 converts out of a population of 382,000,000. In northern India (Bengal, Bombay, and the Northwest Provinces) 715 agents made 173 converts, at a cost of £34,186 2*s.* 5*d.* And many converts are paid. In Hong-Kong there are 94 communicants and 35 paid native agents. In Egypt and Arabia there are 10 communicants and 7 paid native agents. In Yoruba, after forty years of labor, not five per cent of the people are converted, human sacrifices are not discontinued, while the native Christian adherents decreased last year by 885."

the sacrifice. Bought and sold, kidnapped and forced into a life of prostitution and helpless misery, woman is indeed among the Chinese an object of pity and commiseration. The evidences are constantly before our eyes in our own country, wherever the Chinese are gathered in communities, that her lot here is in no way ameliorated, nor have her Christian surroundings so far, in any perceptible degree, tended to work her elevation or emancipation. It is a work that must first be successfully begun and carried out before we may indulge in the idle dream of Chinese conversion to the doctrines of Christianity. It is another—if not the most important—factor in the Chinese problem which we are called upon to solve, in so far as the Chinese who are to remain among us are concerned, and adds perhaps the most serious complexity to the puzzle.

The children born upon our soil so far are in the main illegitimate, and in all cases are, by the very nature of their surroundings, barred out from possible education in common with the children of our population in general. There can therefore be no common school system which in its proper sense can be made applicable to them. What then occurs? Either they must be debarred from being educated at the public expense, or a school system must be devised for their own separate teaching. In the latter case there will no longer be a *common* school system, but a line of class distinction will at once be drawn, and the virtual introduction of the caste system will begin. Will not this even build higher still the barrier between Christianity and idolatry, and will not the way of conversion be made still more difficult than before?

It has been truly said of the Chinese as they exist in the San Francisco colony that "they are not only not amenable to law, but they are governed by secret tribunals unrecognized and unauthorized by law." These tribunals "levy taxes, command masses of men, intimidate interpreters and witnesses, enforce perjury, regulate trade, punish the refractory, remove witnesses beyond the reach of the courts, control liberty of action, and prevent the return of Chinese to their home in China without their consent." And this system grows out of the inherent quality of the Chinese mind. It is part and parcel of their natures to be their own masters, to acknowledge no law or rule of action not of their own making. It is this quality of mind, this ancestral inheritance, that must be eradicated and changed before the Chinese can be made to stand upon an equality before the law with other American citizens. It adds another to the many complications of the Chinese problem which is before us for solution, and as it involves a change of natural proclivities which can not be brought about except by the slow evolutionary process through successive generations, it be-

comes possibly the most serious complication of all. But literally these complications are endless, and do not admit of further elaboration in this paper. They suggest the conclusion that the Chinese question, whether exclusion excludes or not, is so far from being finally disposed of, that it is now assuming its gravest and most important aspect. While we may well wish that the Chinaman might have been permitted to remain at home to enjoy his opium *cum dignitate*, yet regrets on this point are worse than useless, and the question now is, that, having him, like the poor, always with us, what shall we do with him?

GOVERNMENTAL AID TO INJUSTICE.

By GEORGE M. WALLACE.

PLACED in a world in common, with every degree of financial ability, positive and negative, we are all spurred on by common necessity, by common desire to escape hunger, cold, disease, and death. To this end we enter the business arena and struggle for bread, each offering for sale something he has himself produced in return for like offerings from others. In this arena we find the successful business man offering for sale a hundred tons of steel rails; beside him is a slender girl offering for sale the labor of her hands for ten hours. The commodity offered by each, by each has been produced: the business man's from a hundred tons of coal burned beneath a dozen boilers, perhaps; the young girl's, worked up in a physiological laboratory, comes from a night's rest, a morning and midday repast.

So long as each has produced his and her own offering, and is allowed to enjoy to the full the fruits of his and her own effort, no one shall say him nay if the business man offsets the muscular energy of the young girl by a thousand or by ten thousand fold. Neither economics nor morals shall stint or limit the business man's returns so long as legitimate business methods alone are adhered to, so long simply as business men are content to take what they have produced, and leave to others their own productions. In a purely democratic country each should enjoy all the freedom which is consistent with a like amount of freedom in others, and each should be given full right to the enjoyment of the fruits of his own effort. The maintenance of this status is the best function and only justification of government. Just as church and state, or science and religion, are best separated, so politics and business should be divorced. The latter, depending on the natural resources of a country, should not be made to fluc-

tuate with every breath of public opinion, the medium on which politics depends; while for government to step into the business arena and assist one party or the other is as immoral, financially, as for the umpire of a ball-game to play upon one side or the other by partial decisions.

In 1887 steel rails were selling in the markets of the world for twenty dollars per ton. Like a wall around the United States, there was a protective duty of seventeen dollars, and steel rails were selling within this country at thirty-seven dollars per ton. Protection removed foreign competition, a trust removed domestic competition, and the two carried prices to the very limit. Here the business men of Pittsburg had gone out of the purely business arena—they had stepped into politics, had got the United States Government into their business as a business factor, and, securing to themselves the surrender of a part of its taxing power, they had government, which is only just when impartial, playing on their side.

Now note, the business man by government partiality gets thirty-seven dollars per ton where otherwise, or in the markets of the world, he could only get twenty. He has a rise in price on steel rails of seventeen dollars per ton. The young girl has worked a day and got a dollar; she wants ten yards of calico, and goes to a store and gets it at ten cents a yard, and pays the dollar her day had produced. The store-keeper would have charged only nine cents a yard but for extra freight he had to pay; the railroad charged extra freight because of the increased cost of its steel rails. In other words, when, by government interference on behalf of the business man, the price of steel rails was carried from twenty to thirty-seven dollars per ton, the railroad got it back by increased freights and the merchant by increased prices. The young girl got it back from nowhere; her ten cents was passed over to the merchant, who passed it over to the railroad, which passed it over to the business man.

Government, which can produce nothing, has wrought a different distribution of wealth; the business man gets all he earns as before, but also gets one tenth of the earnings of the young girl. Government is no longer just, because no longer impartial; the girl is no longer free, because not permitted to enjoy in full the fruits of her own labor. Ten cents apiece, once a year, from a hundred thousand persons, made up of young girls, boys, babies, sick and old folks, and the poor generally—for the tax can always be landed upon the poor at last—make ten thousand dollars. That ten cents to the young girl was blood-money; she will be less well clothed, less well nourished, and, taken from supplies already scant, it may mean hunger, cold, and even death to her. To the business man it may mean a cigar, or a stick of chewing-gum for

his child, or, put with other forced contributions, the total may take his daughter to Europe for a pleasure-trip.

Here is one of our great captains of industry, assisted by accumulated capital and corporate franchises as well as the ability which makes him a captain of industry, competing in the industrial arena for the necessaries and good things of life with a frail girl who has only a one-girl power to depend on, and of the two he it is we find asking government aid, and aid to do what? Why, to take away to himself all his own and a part as well of the poor girl's earnings.

This in what ought to be the manliest country in the world, on the part of that section of our manhood best fitted by nature for the financial struggle for bread, and aimed by these financial giants at the weakest section of the community. We may talk about the ferocity of the Northmen tossing up babies and catching them on their spears, or about atrocities practiced in Russia to-day; we may imagine a Sullivan calling for steel knuckles with which to encounter a seven-year-old boy; but we can not believe that American manhood will not some time rise above the unparalleled meanness of the protective tariff.

ISRAELITE AND INDIAN: A PARALLEL IN PLANES OF CULTURE.*

By GARRICK MALLERY.

II.

PARALLEL MYTHS.—The early religious opinions and practices of all peoples appear in myth and by myths are explained. When a religion has endured among a people for a long time after the use of writing has become general, its myths are collected and collated and formed into a system. This system generates dogmas which require support from glosses on the text of the original myths; indeed, these texts are often buried under a mass of homilies and predications, or, when still used in their purity, are interpreted *ad libitum*. Such is the history of the myths and the religion of Israel.

The Indians have myths and legends which explain their religious opinions and practices; but, as they did not acquire the art of writing, they did not formulate articles of faith. Their beliefs must be ascertained, therefore, by the collection and study of the myths themselves as now reduced to writing and translated. The

* Address of the Vice-President of the American Association for the Advancement of Science, Section H, Anthropology, delivered at the Toronto meeting, August, 1889.

comparison of the myths of the Indians with the myths of the Israelites displays striking similarity and exhibits more clearly than a mere statement of doctrines the likeness of the religions of the two peoples. The likeness of the two collections of myths to one another, and their comparison with similar collections from other peoples, indicates that when the same events are represented as occurring everywhere, they really occurred nowhere, but were the mental conceptions of men in the same stage of intellectual culture.

It is not necessary to mention deluge legends common in all countries where inundations have occurred, and only a general interest attaches to the mythical culture hero. He was sometimes an inspired man, and sometimes a benevolent god in shape of man, but in his more archaic forms he was a beast with human metamorphoses. He taught all that is known of hunting, fishing, the properties of plants, picture-writing, and indeed of every art, and founded institutions and established religions. After his achievements he generally disappeared with mystery, his actual death being seldom established, leaving a hope of his return as a triumphant benefactor. The legends relating to Michabo, Ioskeha, Hiawatha, and Manabosho will occur to all special students as showing their analogues in the biography of Moses. But the point of peculiar interest is that the myths referred to are not only similar generically, but that they are strikingly identical in their minute details with those of the Israelites. A few of them will be noticed.

It will be understood that in all instances presented scrupulous care has been taken to eliminate European influence and to obtain assurance of the aboriginal and ancient origin of the legends.

An Ojibwa tradition tells the adventures of eight, ten, and sometimes twelve brothers, the youngest of whom is the wisest and the most beloved of their father and especially favored by the high powers. He delivers his brothers from many difficulties which were brought about by their folly and disobedience. Particularly, he supplies them with corn. A variant statue of Lot's wife who, after escaping from the destruction of her village, was turned into stone instead of salt, is still shown near the Mississippi River. The Chahta have an elaborate story of their migrations in which they were guided by a pole leaning in the direction which they should take, and remaining vertical at each place where they should encamp. A still closer resemblance to the guidance of the Israelites in the desert by a pillar of fire is found in the legendary migrations of the Tusayan, when indication was made by the movement and the halting of a star. The Pai Utes were sustained in a great march through the desert by water which continually filled the magic cup given to the Sokus Waiunats in a dream,

until all were satisfied; and a similarly miraculous supply of food to the starving multitude is reported by the same people. In the genesis myth of the Tusayan, the culture-hero was enabled to pass dry shod through lakes and rivers by throwing a staff upon the waters, which were at once divided as by walls.

Among the Ojibwa traditions there is a variant of the conception that man could not look upon the form of a divine being and live. According to these traditions the divine beings were obliged to wear veils, and when one of them unintentionally let his eyes fall upon the form of a man the man fell dead as if struck by lightning.

The Midéwiwin rite was granted to the Ojibwa at a time of great trouble, through the intercession of Minabozho, their universal uncle, and at the same time rules of life were given to them, which are still represented in hieroglyphics on birch-bark. They have a resemblance in motive to the Biblical legends and laws. At the time of a great pestilence, which came "when the earth was new," the Ojibwa were saved by one of their number to whom a spirit, in the shape of a serpent, revealed a root which to this day they name the "snake-root," and songs and rites pertaining to the serpent are incorporated in the Midéwiwin.

Mr. W. W. Warren, in his "History of the Ojibwa Nation," tells that he sometimes translated parts of Bible history to the old Ojibwa men, and their expression invariably was, "The book must be true, for our ancestors have told us similar stories generation after generation since the earth was new." Only last year a well-informed representative in Washington of the Muskoki answered questions about the myths and legends of his people by the simple remark: "They are all in the Old Testament. Read them there, without the trouble of taking them down from our people."

SOCIOLOGY.—The golden age of the Israelites, as recorded in the Old Testament according to modified tradition, was the age ending with the Judges. The people lived in a state nearest to their ideal under a supposed theocracy, which really was not instituted until the days of Ezra and Nehemiah. The exploits of Gideon, Jephthah, and Samson are pictures of antiquity equal in grandeur and like in import to those of the Homeric heroes. If the Indians could have written about their own past, they would have portrayed a similar golden age, which, indeed, is mirrored in their traditions and myths.

But it must always be borne in mind that the Indians were not nomads, and were never in the true pastoral stage; hence their tales of the good old times were more archaic than those presented to us in the Israelite records.

Nomadic life requires the possession of either domesticated

animals for sustenance or of burden-bearing animals by whose aid fresh game areas may be readily occupied. The persistent nomads—e. g., the Arabs—have possessed both kinds of animals. The Indians had neither. The large majority of the historic Indians never saw a horse until centuries after the Columbian discovery. The Dakota, Comanche, and some other tribes became nomads adventitiously, and only after the introduction of the horse by Europeans. The means of subsistence of these tribes in a nomadic life were afterward increased by their obtaining firearms.

The pastoral stage also depended upon the possession of some of the animals mentioned. It expedited the transition of the Israelites from savagery to barbarism, but it was not experienced by the Indians. Therefore, supposing that the two peoples were at one time equally advanced in culture, it might well have required three thousand years longer for the Indians to reach the stage in which they were discovered than for the Israelites to attain to the culture shown in the days of the Judges.

At the time taken for proper comparison between the two peoples, which has before been designated, both were living under the clan or totemic system, which was formerly called the gentile system.

A clan is a body of kindred in which kinship is established by laws now long disused, and so strange to our present ideas as to be comprehended with difficulty. Some of the more salient features of the system appear in the division of the people into tribes which are interpermeated by clans, with special rules of government, adoption, punishment, protection, property, and marriage.

The totemic stage was first intelligently noticed among the aborigines of America and Australia, and typical representations of it are still found among them. In Australia it is called *kobong*. An animal or a plant, or sometimes a heavenly body, is connected with all persons of a certain stock, who believe that it is their totem, their protecting daimon. They regard themselves as descendants of the totem, and they bear its name. The line of descent is normally female. When a clan becomes dominant, its totem daimon prevails together with it, and commands the worship of all the clans or tribes in the group, the daimons of other clans and tribes becoming subordinate.

The clan system, lately found in actual force in two large geographic divisions of the world, has preserved a clew to the moldered maze of man's early institutions. What is now known of the clans, tribes, and league of the Iroquois explains what was formerly mystical about the tribes of Israel.

Each clan or tribe took as a badge or objective totem the representation of the totemic daimon from which it was named.

It was generally an animal—e. g., an eagle, a panther, a buffalo, a bear, a deer, a raccoon, a tortoise, a snake, or a fish, but sometimes one of the winds, a celestial body, or other impressive object or phenomenon.

The Israelites had such badges or totems which have been called standards. The blessings of Jacob and of Moses, which mention several of them, were not merely metaphoric. In the blessing of Jacob, Judah is named as a lion, Issachar as an ass, Dan as a serpent, Naphtali as a hind, Benjamin as a wolf, Joseph as a bough. In that of Moses, four such names occur—Ephraim as a bullock, Manasseh as a bison, Gad as a lion, and Dan as a lion's whelp. From all the evidence on the subject there is reason to believe that these were the leading totems in the tribes mentioned, and the discrepancies in the lists may be accounted for by the fact that the head clans in some tribes had changed in the interval.

David seems to have belonged to the serpent stock. The most prominent among his ancestors bore a serpent name. Some passages in his life show his connection with a serpent totem.

Critics have doubted whether Moses was as much opposed to idolatry as is asserted in the records, for a brazen serpent, perhaps an ancient idol of Jahveh, said to have been set up by him, was in existence until the reign of Hezekiah, who broke it into pieces. True, it may have been an idol of Jahveh, or perhaps it was worshiped as a teraph; but it may have been simply a totem. The lifting up of the brazen serpent by Moses in the wilderness may be more consistently explained by totemism than by idolatry in its usual sense.

Government.—The Israelites in their normal condition were governed by a number of their elders who were presumed to have the greatest wisdom and experience. Special powers were conferred in emergencies upon one man and were intended to be of short duration, but while they lasted they were dictatorial. The judges were despots without a standing army or an organized government. Their selection was due neither to inheritance, to suffrage, nor to violence, but to personal superiority in strength, wisdom, and courage. The usual result was, that the power gained by a ruler was held during his life, and it was sometimes contended for by one of his sons with temporary success. The government of the Indians was substantially the same.

The alliance of the tribes was loose. They seldom hesitated to make war upon one another. Even after nationality had been initiated, the genius of David and the magnificence of Solomon could not permanently weld them together; and doubtless without the later and cohesive establishment of Jahvism they would have often, though perhaps but temporarily, fallen back into an incoher-

ent state. The Indians did not gain such a conservative bond, and the alliances of their tribes were more loose and transient.

The characteristics of the Israelite and of the Indian, as of the Homeric Achæans and of the extant Bedouins, were predatory. The tribe and its clans, with their occasional allies, went forth against the rest of the world.

In the investigation of totemism among the Israelites it is important to observe its continued existence in Arabia, because the state of society there still remains more primitive than that prevalent in the land of Israel even at the time of imposing antiquity when the Old Testament was written.

A large number of tribes having animal names are still found among the Arabs. Some of these tribal names are Lion, Wolf, Ibex, She-fox, Dog, Bull, Ass, Hyena, and Lizard. The origin of all these names is referred by the people to an ancestor who bore the tribal or gentile name. The animal names given in the tribal genealogies are also often found belonging to sub-tribes, the same animal name sometimes occurring in subdivisions of different tribes. These particulars correspond with the Indian clan system.

The tribes of the southern and eastern parts of Canaan had affinities both to Israel and to the Arabs. The Arab princes of Midian were The Raven and The Wolf—heads of tribes of the same names. More than one third of the Horites, the descendants of Seir the He-goat, bear animal names; so do the clans of the Edomites. The real name of Moses's father-in-law is in dispute, but he had some connection with the Kenites. The list in Genesis xxxvi is a count of tribal or local divisions and not a literal genealogy. It is full of animal names. The Antelope stock was divided over the nation in a way only to be explained on the totemic and not on a genealogic system. The same names of totem tribes that appear in Arabia, reach through Edom, Midian, and Moab into Canaan, where they show local distribution, which is intelligible only on the assumption that the totemic system prevailed there also when the first books of the Old Testament were written.

Prof. Robertson Smith gives a select list of about thirty persons and towns in point, bearing names derived from animals and plants. Dr. Joseph Jacobs has expanded that list into a hundred and sixty such names, though he considers their importance to be lessened by the frequency of such names in England, forgetting, apparently, that the clan system also existed among the ancestors of the English people.

The twenty-sixth chapter of Numbers gives the clans of the Israelite tribes. Altogether seventy-two clans are mentioned, and of these at least ten occur in two tribes, among which the Arodites or Wild Ass clan, found both in Gad and in Benjamin, should be

noted. Other clans also have animal names: the Shillimites or Fox clan, of Naphtali; the Shuhamites or Serpent clan, of Benjamin; the Bachrites or Camel clan, of Ephraim and Benjamin; the Elonites or Oak clan, of Zebulon; the Tolaites or Worm clan, of Issachar; and the Arelets or Lion clan, of Gad.

A special suggestion comes from the tribe of Simeon. In the blessing of Jacob, Simeon is coupled with Levi as a tribe scattered in Israel. Some Simeonites lived in the south of the territory of Judah, but they do not appear there as an independent local tribe. It would seem that Simeon remained as a divided stock, having representatives through the female line in the different local groups. When the old system was transformed, Simeon lost importance and ultimately dropped from the list of tribes. The name of the tribe was lost but not the people, as has been noticed also in careful statistical examination of the Indians.

The tribe of Judah received the powerful accession of the Dog tribe, the Calebites (to be again mentioned), among whom there were many animal names.

In view of the above, and the additional fact that the early Israelites freely intermarried with the surrounding nations, it becomes highly probable that the totemic system of those neighbors existed in all Israel, as was obviously the case in Judah.

Punishment.—In the stage of barbarism man belongs not to himself, but to his clan and tribe. In civilization crime is the act of an individual for which he is responsible to the whole community, and there can be no crime without a malicious intent. In the totemic stage the clan was responsible to all its members and to all other clans for the offense of any of its own members, and the act itself, not its intent, constituted the offense. Hence the rules respecting obedience, punishment, and protection differ from those of civilized man.

Punishments among the Indians were chiefly death or expulsion from the tribe—the latter, from the unprotected state of the offender, being tantamount to death. The code consisted in the application of the *lex talionis*. The vengeance of blood for homicide was exacted as a clan duty. It was executed by the clan of the person killed, generally by the nearest of clan kinship, and it was required even if the death were by accident, unless the killing was condoned by payment. Among the Israelites the *lex talionis* was likewise the fundamental law, and the duty of blood revenge also devolved on the kin by the mother's side—i. e., the kindred according to the normal clan system.

Sanctuary.—The doctrine that no crime could be individual, but might be committed against a clan by a clan through one of its members, rendered it necessary to have some special provision

to restrict vengeance and maintain peace. Hence the right of sanctuary, which appeared later as a prerogative of religion, was in its origin sociologic.

The avenger of blood among the Indians generally had the right to slay the criminal if found within a specified time, for instance, two days after the act; but if he should escape beyond such period, the avenger could no longer pursue, and was himself liable if he should persevere. The clan or clans concerned interfered at that stage in prescribed modes. Among some tribes localities (called by Adair the "cities of refuge") were designated, in which the accused could remain in safety until the general settlement of accounts at the next annual festival. Compare Numbers xxxv, 12: "And they shall be with you cities of refuge from the avenger; that the man-slayer die not, until he stand before the congregation in judgment."

The functions of the avenger of blood are only referred to in the Pentateuch, but were well known in ordinary cases. The law treats of the exceptional circumstances of an accidental homicide. There is a trace, in Deuteronomy xxiii, of the general communal sanctuary in Israel. It enacts that any town or village shall be an asylum for an escaped slave. In Exodus xxi, the altar (presumably any one of the numerous village altars) is mentioned as a refuge. In the cities of refuge the sanctuary was used only for the mitigation of the revenge of blood.

A mode of bringing to notice the barbarian stage of the Israelites at the time under consideration is to translate into English familiar personal names from the Old Testament, such as the Dog, the Dove, the Hyena, the Lion's Whelp, the Strong Ass, the Adder, and the Running Hind. This brings into immediate connection the English translation of Indian names, such as Big Bear, White Buffalo, Wolf, Red Cloud, Black Hawk, Fox, Crow, and Turtle. Such Israelite names were probably of Gentile origin, that is, from the clan or gens, for the Israelites were surely Gentiles in the true sense, although later they abjured the charge. But individuals among them may also have adopted such names because they could be represented objectively. Such selection is made by some Indians apart from their totemic designation. Indians possess very few names that can not be represented in pictographs; and the very large topic of tattooing is connected with this device antecedent to writing. The compilers of the Old Testament probably desired to break down a former practice, as is shown in Leviticus xix, 28: "Ye shall not print any marks upon you." And there are other similar indications.

Adoption.—The early history after the exodus shows many cases of adoption from among the neighboring tribes in which the captive or the stranger adopted became a member of one of

the clans. This was an essential part of the totemic system as is noticed universally among the Indians. Without membership in a clan there could be no status in the tribe.

Caleb is first known as the son of Jephunneh, the Kenezite. Next he appears as a chief of the tribe of Judah; finally, in the book of Chronicles, his foreign descent is lost. He becomes Caleb, the son of Hezron, the son of Judah. This is an instance of adoption and is not contradictory. He is first described in accordance with his actual descent, but when adopted with his family and followers, who probably formed a sub-clan, he would be called by the name of the family that adopted him.

The whole population of the country which, according to Deuteronomy, was doomed to be exterminated, slowly became amalgamated with the invaders. In this way alone their rapid increase can be accounted for.

The doctrine that no quarter should be shown to the enemy and no alliance should be made with the Goim (a word meaning the "nations," with the implication of "heathen") was not established until the late prophetic influence. The use of the word Goim dates from the ninth century B. C. It is gratifying to be convinced that the stories of the wholesale extermination and cruel outrages injected into the historical narrative were afterthoughts intended to be examples for the future, and that they never actually occurred. If the stories are true, the brutality of the Israelites to the conquered was more horrible than that of the Indians, among whom captivity was tempered by adoption.

An interesting custom of the Indians connected both with the rite of sanctuary and that of adoption is that called by English writers "running the gantlet." When captives had successfully run through a line of tormentors to a post near the council-house, they were for the time free from further molestation. In the northeastern tribes this was in the nature of an ordeal to test whether or not the captive was vigorous and brave enough to be adopted into the tribe; but among other tribes it appears in a different shape. Any enemy, whether a captive or not, could secure immunity from present danger if he could reach a central post, or, if there were no post, the hut of the chief. A similar custom existed among the Arikara, who kept a special pipe in a "bird-box." If a criminal or enemy succeeded in smoking the pipe contained in the box, he could not be hurt. This corresponds with the safety found in laying hold of the horns of the Israelite altar.

Land.—In the earlier history of the Israelites there could be no individual property in land—it belonged to the clan, as it did among the Indians. After arriving at sedentary and national life the Israelites found it expedient to permit a compromise between

the permanent possession of land by the clan and a right of individual occupancy for periods sufficient to offer a proper stimulus for improvements. This was done by the institution of the Sabbatical year or the year of jubilee. The Indians, not having reached the true sedentary stage (except in rare instances), were not obliged to invent that device. Thus it holds true among both peoples that no man could acquire an absolute property in land. The estate was not in him but in his clan.

Forbidden Food.—The Indians long observed a prohibition against killing or eating any part of the animal connected with their totem. For instance, most of the southern Indians abstained from killing the wolf; the Navajo do not kill bears; the Osage never killed the beaver until the skins became valuable for sale. Afterward some of the animals previously held sacred were killed; but apologies were made to them at the time, and in almost all cases a particular ceremony was observed with regard to certain parts of those animals which were not to be used for food on the principle of synecdoche, the temptation to use the food being too strong to permit entire abstinence. The Cheroki forbade the use of the tongues of the deer and bear for food. They cut these members out and cast them into the fire sacramentally. A practice reported this year as still existing among the Ojibwa is in point, though with instructive variation. There is a formal restriction against members of the bear clan eating the animal, yet by a subdivision within the same clan an arrangement is made so that sub-clans may among them eat the whole animal. When a bear is killed, the head and paws are eaten by those who form one branch of the bear totem, and the remainder is reserved for the others. Other Indians have invented a differentiation in which some clansmen may eat the ham and not the shoulder of certain animals, and others the shoulder and not the ham.

The Egyptians did not allow the eating of animals that bore wool. This prohibition has been attributed to the sacred character of the sphinx, and it has other religious connections. It is supposed by some writers that the legislation of Moses with reference to forbidden food was aimed to antagonize social union with the Egyptians by prohibiting to the Israelites edibles generally used by the Egyptians, and *vice versâ*. It is true that some kinds of food forbidden to one of these nations were allowed to the other, but the rule was not general, and in particular the abstinence of both peoples from swine is inconsistent with the hypothesis. A more conclusive criticism is that the legislation so interpreted would have been too late for application. The Israelites had left Egypt before even the alleged time of its promulgation.

The survival of totemism may be inferred from the lists of forbidden food in Leviticus xi and Deuteronomy xiv. It would

appear that about the time of the exodus the Israelites were organized on the basis of families or clans tracing through female lines, and named Hezir (swine), Achbor (mouse), Aiah (kite), Arod (wild ass), Shaphan (coney), and so on. Each of the clans refrained from eating the totem animal, or only ate it sacramentally. As the totemic organization declined, the origin of the abstinence would be lost, but the custom lasted, and when the legislation was codified it was incorporated in the code. The hypothesis would explain certain anomalies in the list—e. g., coney, or rock badger, for which no other explanation deserving attention has been given. The division into clean and unclean food by the two tests of cloven foot and rumination was a later induction from the animals regarded as *tabu*. This is confirmed by the want of any systemization in the list of birds given in Leviticus.

It would accord with other examples in totemism that animal names connected with the animal worship before mentioned should be adopted by clans, and by individual men among the Israelites. There is some evidence that men, bearing a common animal stock name, though in different tribes or nations, recognized a unity of stock. Our most definite information on the subject is derived from Ezekiel viii, which indicates that the head of each house acted as priest, the family or clan images, which are the objects of idolatry, being those of "unclean" reptiles or quadrupeds—i. e., those which are prohibited from use as food. Although the whole inference of Prof. Smith on this subject is not admitted by Dr. Jacobs, his objection is to the survival, not to the early existence, of the cult.

No satisfactory explanation of the Israelite division between clean and unclean animals, apart from that afforded by the totemic system, has hitherto been made. No rational motive can be assigned for the avoidance of certain animals, in themselves hygienically good. The explanation that swine's flesh was liable to bring disease, and therefore was prohibited for a sanitary reason only, covers but a small part of the subject and is not in itself satisfactory. The meat of the hog is, in fact, as wholesome in Syria as it is in Cincinnati, and the discovery of trichinosis had certainly not been made in the times under consideration. The avoidance of all meat, indeed of all food, for purposes of fasting and producing ecstasy, is in a different category and has already been mentioned.

Marriage.—The laws of marriage in the stage of barbarism are intricate, but attention may be directed to a few points which strongly distinguish them from the marriage laws of civilization. Their most general characteristic is the regulation of marriage within strict limits of conventional kinship.

The levirate, named from the word *levir*, a husband's brother, is in brief the customary right and obligation combined of a brother—normally the eldest surviving brother—to marry the widow of his deceased brother. Prof. E. B. Tylor reports that this law appears among one hundred and twenty peoples—i. e., in about one in three of the distinct peoples of the world. It was almost universal among the Indians, sometimes with additional duties and privileges. A widow, as a rule, could not marry any one but her deceased husband's brother except on his refusing to marry her, nor until after a long time of mourning, or more properly of ordeal, after which she could be freed from the *tabu*.

In several tribes marrying an elder sister gave to the husband rights over all the other sisters of the wife. Sometimes the son-in-law, especially when he married the eldest daughter, became entitled to all the younger sisters of his wife at his option. Other men could not take them except with his formal consent. This right of the son-in-law to all the unmarried younger sisters sometimes continued after the death of the first wife. Not unfrequently a man married a widow and her daughters at the same time.

Among the Israelites it was common to have several wives of equal status, who often were sisters. A widow had a right to appeal to her brother-in-law, or some member of her husband's family, to provide her with a second husband, and an evasion of the duty *in personam* was a gross offense. Deuteronomy xxv shows the degrading terms of the formality by which alone the brother-in-law could be freed from the obligations of marriage and the widow be allowed to marry another man. Judah admitted that Tamar's conduct was perfectly correct. It was but a legitimate extension of the levirate law.

There is the clear statement in Leviticus that the Egyptians and the Canaanites formed such marriages as were in accordance with the totemic system, but which were made incestuous by the Israelite law. The laws of incest given in Leviticus are probably later than the code of Deuteronomy, in which the prohibition is directed against marriage by a man with his father's wife. That precept denounces the practice in Arabia by which the son inherited his father's wife.

In the framework of the Deuteronomic code there were three incestuous prohibitions, viz., father's wife, sister, and wife's mother. To these offenses Ezekiel adds marriage with a daughter-in-law. According to the prophets, all those forms of *quasi*-incest were practiced in Jerusalem; and the history indicates that all at some time were recognized customs. The taking in marriage of a father's wife was not wholly obsolete in the time of David.

As regards the Israelite system of descent in the female line, it may be noticed that the children of Nahor by Milkah were dis-

tinguished from his children by his other wives. Rebekah's descent is practically valued as descent from Milkah, and the family or clan connection is traced entirely through Milkah and Sarah. Their rules of kinship regarding what we now call incest are partly indicated by the following instances: Moses' father married his father's sister; Nahor married his brother's daughter; Abraham married Sarah, the daughter of his father but not of his mother.

A passage in Judges relates to exogamy, recording that Ibzan had thirty sons, and also thirty daughters whom he sent abroad, and took thirty daughters from abroad for his sons. But exogamy could not be kept up after the Israelites had become mainly an agricultural people, and in the times of the kings only survivals of it remained.

Mr. John Fenton, in "Early Hebrew Life," makes some acute remarks upon the story of Lot's daughters, but he did not exhaust the subject. According to the clan system, it was not only proper for Lot to marry his daughters, but under the circumstances it was obligatory upon him to do so. The logical propriety of the marriage of a father to his daughters, on the ground that they did not belong to the same clan, is clear, and the practice exists to-day among a number of the tribes of Indians not much affected by European intercourse. A father was not of kin to his own children. They belonged to the mother's clan, and not to his. An interesting example of this clan law is furnished by Dr. George M. Dawson as still existing among tribes of British Columbia. A certain rich Indian would have nothing to do with the search for his aged father, who was lost and starving in the mountains. He did not count his father as a relative, and said, "Let his people go in search of him." Yet that son was regarded as a particularly good Indian.

There are other instances in which the son would fight against the father to the death. Such cases would occur where, according to the obligations of clan law, a son married a woman of a clan other than that of his father and went to live with her people; and when there was warfare between her clan and that of his father, the son was by association expected to fight against his father. The real tie of blood gave no reason why he should not be alien and antagonistic to his father and his father's clan.

But it is true that, in many tribes of Indians, since they have been observed by Europeans, the marriage of father and daughter has been very rare. It may be suggested as a reason that a gradual change has occurred from the mother-right to the father-right, in which the attitude is reversed; but practically the fact that, by treating the daughter as an object of value or merchandise, either the father or mother could secure presents from the suitor, naturally tended to break down this part of the clan mar-

riage system before any other, and, the custom ceasing, the practice became wrong. So it is true to-day among Indians, as it was in a much more marked degree among the Israelites at the time of the compilation of the existing version of the Old Testament, that the marriage of a father and daughter is reprobated. In this connection it is instructive to notice that the Navajo have a myth, undoubtedly genuine, that in the old time one of their race took his daughter to wife, and their offspring became the ancestor of the Utes, the hereditary enemies of the Navajo. This is a parallel with the stigma inflicted upon the Moabites and Ammonites, who were the descendants of Lot and the enemies of the Israelites who wrote the history, but yet were recognized by the latter as of the same stock.

The part of the story of Lot as it appears in our version, which tends strongly to show its later manipulation, is that the authors of that version, having at that time the idea of a horrible incest, explained that the man, specially designated by tradition as eminently good, was guilty only because he was betrayed through intoxication. They were obliged, in accordance with one tradition, to make him the ancestor of Moab and Ammon. By another tradition he was left without any sons and no wife, the two daughters being all of his family who survived the destruction of Sodom. They reconciled their data, therefore, by the excuse of intoxication, but there was no occasion for such excuse. In the age to which the tradition related the transaction was perfectly proper, did not involve sexual passion, and was required by law to keep up the stock. The clan rules had been forgotten when the book of Genesis was written.

In the stage of barbarism the marriage of brother and sister was common all over the world. Where polygamy existed, as was the case among the Israelites, and probably among all the Indians, a man, according to the rules of the totemic system, could not marry into his own clan. If he took several wives, they would sometimes be of different clans, not only from his own, but from one another. In such cases, the child of the wife of clan A was not of the same clan as the child of the wife of clan B, and they could marry. The marriage of uterine brothers and sisters was not consistent with the clan rules.

Writers on the clan system have extolled it as a system showing profound physiological insight respecting the supposed evils of inbreeding; but the best and latest physiologists doubt whether inbreeding is bad, unless there is a taint of blood which should prohibit the marriage of either party to any one. A true understanding of the clan system would have shown that inasmuch as it certainly permitted marriage between a man and his half-sister, and between a man and his aunt, his father's sister, if not the

more violent case of marriage between father and daughter, it did not accomplish that for which it has been so highly praised.

The late prohibition of a man's marriage to his deceased wife's sister can not be successfully defended on any principle of physiology or sociology. It is a blunder that perhaps arose in the transition stage from the matriarchate to the patriarchate method.

CONCLUSIONS.—The Indians have been characterized as peculiar among the races of men. One school of writers has pronounced them to be *ferœ naturœ*, and wholly incapable of receiving civilization. Others have held the opposite view, that they were eminently spiritualistic, as was proved by their having preserved the pure pristine faith to a degree beyond all other secluded peoples. Both of these assertions are disproved. When Indians have been allowed reasonable opportunities, they have advanced in civilization, and have thriven under it. While their religion may in one sense be pristine, it does not differ materially from that found in many other regions.

The peculiarity of the Semites, and especially of that branch of them lately styled the Syro-Aramæans (which is only an ethnographic name including the Israelites), has been accepted as an axiom. It was pronounced that they were specially adapted to a spiritual religion; that whether through an exclusive revelation, or because their racial constitution was exceptionally receptive to such revelation, their idiosyncrasy disposed them readily to spiritual ideas, which to modern minds means monotheism. This is not the record of the historical books of the Old Testament, even after their manipulation. The prophets of Israel declared the exact contrary; they denounced their own people as rejecting spiritual truth, and as not deserving the favor of Jahveh.

The historical books of Israel which we possess are not historical records, but are historic legends reduced to writing by writers who had sometimes political and sometimes religious ends in view. The argument of those tales is that all the people habitually worshiped Jahveh, and him alone, during which normal period they were prosperous, but that sometimes under evil influence they abandoned him and fell into disaster, until, after sufficient chastisement, they returned to the true worship. The historic truth is that the old Israelites, when disasters came, as they always do come, gave up the worship of their national god as not a success, and tried the gods of their neighbors. They returned to Jahveh because the other gods did not satisfy them any better. In fact, the people had no fixed or distinct faith, and it is not correct to accuse them of backsliding when they were only vacillating.

The prophets tried to pull the Israelites too rapidly through

the zoötheistic and physitheistic stages into monotheism, and spasmodically succeeded; but the body of the people never reached the stage of monotheism until after the Babylonian captivity. Most writers have explained this on the theory that the terrible chastisement of that captivity finally brought them to submission; but it is more probable that their forced relations with their more cultured conquerors gave them new ideas never before entertained, which infused modifications into their religion. The resulting combination produced those characteristics of that religion which have been regarded as the most admirable.

The general account of the Israelite lapses is not unlike that given in modern times by missionaries, who also have been impetuous in attempting the instantaneous transport of Indians through stages that are marked by ages. Tribes of Indians have been converted, and they were reported and recorded as being in that permanent condition. A few years later, from some dissatisfaction, they returned to their shaman and their dreams, which return was then reported as a lapse. It was not, in fact, a lapse, but the claim that they had been converted was premature. There is, however, this distinction between the Israelites and the Indians: that the former were allowed to return to Palestine and carry out their old ideas with improvements; while the Indians, remaining under the same foreign influences and continually growing weaker, were forced to abandon all their faith and to accept that of their conquerors without composition.

The stories of the conversion of Indians by thousands would seem false to one who did not know that they were ready to believe any new thing because they before had no fixed belief. The record of the Israelites is not so clear, because old; but they surely adopted the Satanic doctrine and the "Mosaic cosmology," and continued adopting foreign beliefs until a late date in their history.

The most judicious remarks ever made by missionaries were those of the Rev. Messrs. D. Lee and J. H. Frost, who, after ten years in Oregon of what has been considered successful work, announced their abandonment of their former tenet that if the heathen were converted to Christianity civilization followed of course. They confessed that civilization must begin before Christianity could even be understood. Acute travelers throughout the world have perceived the same fact; and it is not a too violent simile to say that Christianity, belonging to the plane of civilization and to that only, sits on a savage or barbarian as a bishop's mitre would on a naked Hottentot.

The Israelites were not suddenly lifted from their barbarian condition. It was not possible. As regards the culture strata we may take a lesson from geology. Coal is not found in the Si-

lurian formation, therefore wise miners do not look there for coal. The higher mammals are not found earlier than the Cenozoic, though their precursors are in the Jurassic. Man in the savage stage may be examined in the same spirit as the Jurassic stage is studied to trace what may afterward appear in the barbarian and Cenozoic, and is developed in the present epoch; but to search for the complete ideas of civilization in the period of barbarism would be as judicious as to dig for manuscripts among the workshops of flint arrow-heads.

The beliefs and practices of both the Israelites and the Indians were substantially the same as those of other bodies of people in the same stage of culture. They were neither of them a "peculiar" people.

There is, racially, no peculiar people in the sense intended. Mankind is homogeneous in nature, though its divisions at any one time are found in differing and advancing grades of culture. Such advancement has been from causes known to be still in continuous operation. What is called blood in a racial sense may be likened unto the water of the earth: as the water comes from the clouds it is chemically the same, and it is subjected, wherever it is, to the same laws. The early course of a rill may be turned by a pebble, and from the elevations and depressions met it may become a lake, or a river, or a stagnant marsh. From the character of soil encountered it may be clear or muddy, alkaline, chalybeate, or sulphurous. In one sense, which belongs to modern and not to ancient history, the Jews are a peculiar people, from the fact that for many centuries, until lately, they proclaimed themselves to be such, and observed religiously the doctrine about the Goim, and therefore did not intermarry with other peoples; but that should not be a reason for their boasting. Persecution made them pariahs and other peoples would not intermarry with them. During recent centuries the so-styled purity of their race has been kept up by isolation, but the assumption of great purity in the stock at the Christian era is not tenable. Now that their prejudices and those of the Goim against them are dissolving, it is probable that what has been improperly called the Jewish race will disappear by absorption as the Indians are now disappearing. To renew the simile, both Israelite and Indian will be lost in the homogeneous ocean which all mankind seems destined to swell.

It will be noticed that this presentation of views practically ignores the scholastic divisions of mankind into distinct races. The result of my own studies on the subject is a conviction that all attempts at the classification of races have failed. The best statement of the condition of scientific opinion regarding such classification may be taken from the address of Prof. W. H. Flower to the Section of Anthropology of the British Association for

the Advancement of Science. He says: "I am compelled to use the word race vaguely for any considerable group of men who resemble each other in certain common characters transmitted from generation to generation." Some satisfactory solution of the problem may be made in the future, but for the present the most useful direction of the work of anthropologists is not in attempts to establish racial divisions, but in the determination of the several planes of culture with recognition of specific environments.

A rabbinical legend tells that Lot was the first to argue the existence of one god ruling the universe, from the irregular phenomena observed on land and sea and among the heavenly bodies. "If these had power of their own," he said, "they would have had regular motions, but as they had no regularity they were subservient to the occasional exercise of a higher will." In times of greater scientific knowledge these supposed irregular motions are found to be in accordance with laws considered to be permanent, if not immutable, and the recognition of such tremendous laws gives a higher conception of their maker. The notion that such laws are or can be suspended or violated suggests irresolution and caprice, shocks human reason, and clouds the glory of divinity.

The doctrine attributed to Lot is instructive, because the conception of nature implied in it permeated all the early philosophy. We now define a miracle specifically as a deviation from the laws of nature. But to those for whom nature had no laws, the prime definition as "the wonderful" was alone correct. A supernatural being could do anything whatever in accordance with his arbitrary will, and was expected to act in that manner. Men who were inspired or empowered by the supernatural were also expected, indeed were required, to work wonders. It would hardly be a paradox to assert that only the supernatural was natural, and that only the irregular was regular.

That both the Indians and the Israelites were in this stage of philosophy has been conclusively shown. It is also evident that the principle of ancientism was potent in their religion.

Ancientism, which still has surviving influence, declares the old thought, that of the ancient men, to be always the best. This is false, unless the theory is true that all knowledge comes from revelation, which was given only to the ancient men, who therefore had it in its pure condition. To cling to the old merely because it is old is bad; in fact, is the crudest superstition. Some advocates of the old reject all new thoughts, but the more intelligent of its praisers seek to force a reconciliation between the old thought and the new. What they now believe must be right. What they are not accustomed to is shocking, and therefore wrong. So the old, which was always right, must be distorted so

as to comprehend in it the new, which is also right, and whatever there is of the old that can not be managed otherwise must be explained away.

There is an apparent exception in favor of the old thoughts and teachings where there has been a general degradation in culture; then a return to the results of the former and forgotten culture is most desirable. This is illustrated in the revival of the old learning after the dark ages in Europe, when the classic writings as discovered brought fresh illumination to the world. But this was simply a resumption of advance after a check; and the wisdom of the ancients, which has appeared marvelous, owes much of its splendor to the intervening darkness. The process of development, not chronology, makes a proper criterion. Though *antiquitas sæculi juventus mundi*, the archaic is that which relates to the earliest steps of human advance. We have the history of the Israelites for forty centuries; we have that of the Indians for little more than three centuries; and, though the Israelites in recorded times advanced beyond the plane of the Indians, who shall say which of the two peoples is in years the older?

The points before mentioned—that neither the Israelites nor the Indians had any formulated and established faith, and in particular did not believe in a single god, and that they did not have any system of rewards and punishments after death—had important consequences. They were never persecutors for religious opinion. With regard to the Indians that assertion will at once be admitted; with regard to the Israelites it will be disputed by those who take the statements of the compilers of the Old Testament as literally historical.

I have before mentioned one reason, that of the amalgamation of the Israelites with the inhabitants of Canaan, why there could not have been any such fanatic massacre as is narrated. There are other potent reasons. This plane of culture of the Israelites being established, it is proper theoretically to make the deductions belonging to that plane. The Indians carefully concealed their special mystery-daimons. As a matter of fact, the Israelites were generally in accord with their neighbors in religious opinions and practices, so there could have been no antagonism from religious motives. If while worshiping Jahveh they made war for any reason, Jahveh was their reliance, and he conquered or was defeated with them; but they did not make war to force the worship of Jahveh upon others. They would have regarded that as the worst possible policy, as it would have allowed their enemies to pirate upon their divine monopoly which was the essential part of their military equipment.

When men live in the midst of many religions, which imply many revelations, they are charitable to all of them. It is only

the isolated and ignorant who are bigoted. A still higher degree of light gained by those who have come out of the caves of superstition will induce them to imitate the decision of the witty sage with regard to ghosts—he had seen so many that he could not believe in any.

When a future state of rewards and punishments, depending upon belief in a particular dogma, has been established, the attitude of believers becomes antagonistic. They maintain that a denial of their belief is disrespect to their god, and they angrily stigmatize such denial as blasphemy or skepticism, or use some other term of vituperation, and they say that their anger is righteous. But it is simply egotistic. The true ground of their hostility to any dissentient opinion is the cloud cast on their title to future happiness. This must be fought as titles are contested in courts of law, or by the last resort of war, or by such persecution as silences the objectors to the title. But as the Israelites claimed no such title, they were not sensitive about its disparagement. In the religious stage described, neither the Indians nor the Israelites sought to make religious proselytes. The noble motive of missionaries is to save souls; but the peoples now compared could not have had, indeed could not have understood, that motive.

At the commencement of this address the rule was laid down that it was essential to omit all reference to revelation as deciding the points discussed. Many points, however, have been touched upon which properly bring to notice the order of the development of revelation in general, without discussion of its decisive authority. This procedure may be submitted to students of anthropology as applicable to all revelations save those which each one individually credits.

It is evident that some practice existed early for which a natural explanation may be given. This practice became a formal custom which, after a time, was considered to be obligatory under the vague but compelling idea that it was "bad luck" not to observe it. Bad luck is necessarily connected with the supernatural. Hence the custom or the congeries of customs became a religion, and that was always supported and explained at a later time by a myth. That was not necessarily an explanation made by imposture or with intent to deceive, but grew from the curiosity of men and their hurry to account for everything. All such myths are declared to be obtained, through revelation, from a power higher than man. The result is, therefore, that revelation, which is the last step in the evolution of religion, is enounced, by antedating, to be the first step. When supposed revelation is once regnant, men cling to it as a refuge from the doubt which must always result from reasoning on subjects which do not admit of demonstration. Such clinging becomes fanatical with most

men because they dread as the greatest calamity to be cast into the hands of Giant Doubting, who to them is but another name for Giant Despair. But the path of Doubt leads to the portal of Truth.

It has been no part of my purpose in this address to impugn the character of the books of the Old Testament. On the contrary, I regard that noble work as the most important anthropologic record possessed by man—a work which richly repays the most diligent study. I gladly accept it as a genuine record, and believe that, though it has been colored by time and by the work of designing men, it was never invented. It is sometimes said that persons who are absorbed in scientific studies fear or pretend to scorn the Bible. I neither fear nor scorn it. I admire it, and study it, and gain much from it; but no intelligent person takes as of the same authority all its versions, or, indeed, all the contents of the books which are arbitrarily styled canonical, and about the very names and numbers of which scholars, churches, and sects dispute.

The Hexateuch contains that intrinsic evidence of truth which so impressed the Ojibwa elders, before mentioned, who said that the work was true because they and their fathers "had heard the same stories since the world was new." To those who can read it understandingly it is a true story of a plane of culture.

"Now as to myself I have so described these matters as I have found them and read them; but, if any one is inclined to another opinion about them, let him enjoy his different sentiments without any blame from me."

[*Concluded.*]

MENTAL AND PHYSICAL TRAINING OF CHILDREN.

By JESSIE ORIANA WALLER.

I.

MY paper is entitled the "Mental and Physical Training of Children," and I shall begin with remarks on physical training, as it is first in natural order, the physical life beginning before the mental. In these days, when there is a great rage for education, a certain top-heaviness has been produced among children, and the good homely helpmate of the mind—the body—is decidedly neglected. It is looked upon as is the dull but sensible wife of some clever man, whose duty is to get through all the home drudgery. She must be invited out with him, but is ignored in society, and is only tolerated on account of her brilliant husband. Now, I consider the body to be just as important as the mind, and that it ought to be treated with just as much respect,

especially in these days of intense competition, when, given an equality of brains and education, it is the strong body that tells in the long run, and gives staying power. That alone can help the mind to bear the strain, and anything that can assist our children to bear this daily increasing strain is surely not beneath our notice.

It is really surprising to see the amount of trouble and pains bestowed on the proper housing and feeding of horses and dogs, or other domestic animals, while at the same time comparatively little attention is paid to these matters with regard to the rearing of children. Model stables and model kennels abound, while the model nursery is almost wholly unknown. Warming, ventilation, and aspect are all subjects which are thoroughly considered in the stable, while as regards the nursery they are generally left for chance to decide—though the health of a child is surely more important than that of a horse or a dog. We have all stayed in country houses, where the host has taken us over his beautiful stables fitted with every convenience, and have heard his anxious inquiries as to the health of his favorites, or we have been driven to the model cow-sheds, or kennels, but which of us has been taken over the model nursery?

The men can not be troubled about babies! (though they have no objection to puppies or calves)—they leave all that to the women—and the women, that is to say the mistresses, leave it to the nurses, often entirely ignorant though kindly persons, whose chief recommendation is that they are so fond of children! This would seem a ridiculous state of affairs were it not so lamentable.

Two of the best rooms in the house should be assigned to the children, one for the night the other for the day nursery, but this is by no means often done. In small houses where there is but one spare room, it is of common occurrence to see the largest and sunniest apartment set aside for the visitors, who perhaps occupy it for two months in the year, while the children have to live cramped up in a small, sunless garret.

Sunshine is as necessary to the human being as to the plant; and it is said in confirmation of this that, during the Crimean War, Miss Nightingale nursed the wounded soldiers in a hospital one side of which looked north, the other south, and that she observed that the soldiers lying in the wards with a southern aspect recovered far sooner than their comrades in those on the northern or sunless side. In our climate it is hardly possible to have too much sunshine, and the nurseries should certainly have a southern outlook.

Where there is a large family of children the night nursery is frequently overcrowded, and no regard is paid as to whether there is sufficient cubic space for each person. If there be overcrowd-

ing in a hospital, no matter how you ventilate the wards, a high death-rate is the inevitable result, and in the nursery depressed vitality and sickliness as certainly follow upon want of room and air. One thousand cubic feet is not too much to allow for each person.

No nurseries should be papered unless the paper is varnished, for, besides the great risk of putting up an arsenical paper, there is this to be considered—that children are certain to go through some infectious illnesses, after each of which the nurseries must be disinfected and repapered. The best thing for the walls is paint, which can always be washed and disinfected with little trouble, and once on the walls will last for years. Distemper color is the alternative to paint, but with it a dado of paint or varnished paper should be used, as it comes off when touched or rubbed. Distemper should be renewed every year, or after any infectious disease. Nothing that can hold dust should be allowed in the nursery. There should be no carpet nailed down over the floor; it can not be taken up sufficiently often to keep the room sweet, and the accumulation of dust under such a carpet is astonishing. Directly the children begin to romp, the room becomes most unwholesome with its dust-laden atmosphere, flavored by the many mugs of milk that have been spilt, and the many pieces of bread and butter that have been dropped face downward on the carpet during the past year. But I have not space to do more than point out some few things to be avoided, and must as far as possible keep to generalities.

Our lords and masters arrange the diet of dogs and horses with great care; whether the dog should be fed on meat or farinaceous foods, whether the horses should be turned out to grass or fed upon oats or hay, are momentous questions. Any one having the management of horses will notice that a highly fed animal will be able to do a much larger amount of work than one that is stinted and underfed; that a horse fed upon corn is full of spirit, while if turned out to grass it becomes lazy and sleepy, thus proving that food materially affects the spirit and disposition of the animal. And if this be true for one animal, it will be true for all; and it follows that the superior animal—the child—will be equally affected by variations in food, and will require as much care in feeding.

This will hardly be disputed, and yet very rarely is any system followed in feeding children, and if an ordinary fairly educated man were asked to consider the diet of his children, and whether such a diet might not be found which would develop to its utmost the physical powers of each child, he would probably reply that, when he was young, children ate what was put before them, and were none the worse for it. Now, it is impossible to

prove that they were none the worse for an indiscriminate diet. No one can say how many slight illnesses might have been avoided, or how many severe ones might have been insignificant, had the child been in a perfectly wholesome state of body, which can only result when it has lived on proper food. Good blood can only be obtained by good food, while weakly or even diseased constitutions may be greatly amended by simple attention to diet.

How little does the ordinary young mother know of her child's requirements! The first baby is generally subjected to a terrible number of experiments: the mother, perhaps, gives it a new food merely because Mrs. So-and-so's baby takes it, having no notion as to whether it is suitable for her own infant's digestion.

I shall now turn to the important subject of clothing. The first object of clothes (at any rate in such a climate as ours) is to keep the body from being chilled during our incessant variations of temperature, and it is well to remark that the prevention of chill has nothing to do with "coddling," which is keeping the body needlessly warm merely because warmth is pleasant. Clothes should be light, and of woolen material, and should in no way impede free movement.

It may seem superfluous to state facts which are no doubt obvious to every one, but it is not of common occurrence to see a child dressed in a reasonable manner, especially when it is very young. Although I own that children are now more sensibly clothed than was the case thirty years ago, it is still common to see an infant, who can take no exercise to warm himself, wearing a low-necked, short-sleeved, short-coated dress in the coldest weather. The two parts of the body—viz., the upper portion of the chest and the lower portion of the abdomen—which it is most important to keep from variations of temperature, are exposed, and the child is rendered liable to colds, coughs, and lung diseases on the one hand, and bowel complaint on the other. What little there is of the dress is chiefly composed of open work and embroidery, so that there is about as much warmth in it as in a wire sieve, and the socks accompanying such a dress are of cold white cotton, exposing a cruel length of blue and red leg. I can not see the beauty of a pair of livid blue legs, and would much rather behold them comfortably clad in a pair of stockings. If the beauty lie in the shape of the leg, that shape will be displayed to as much advantage in a pair of stockings; if it lie in the coloring of the flesh, beautiful coloring will not be obtained by leaving the leg bare; and from the artistic point of view, a blue *or* red stocking is infinitely preferable to a blue *and* red leg.

There is a comfortable supposition that children do not feel cold so much as grown-up persons, but this is not true. It is a fact that not only has a child less power of generating heat than

the adult, but that it has also a much larger surface in proportion to the mass of its body, and will consequently be far more susceptible to cold. Cold feet cause a great amount of indigestion, and exposure of the large blood-vessels of the thigh during childhood frequently sows the seeds of kidney diseases, to develop in after-life.

Insufficient clothing and much exposure to cold have the effect of making a child appear torpid, benumbed bodily and mentally, and it stands to reason that if its small powers are entirely consumed in merely keeping alive and fairly warm, no vital energy will be left for anything else, and a child has more to do than the adult: it has not only to repair waste, but it has to grow and make new tissue. But it must not be thought that I am a friend to coddling—on the contrary, I believe that, once let a child be clothed from head to foot in wool, it may go out in almost any weather; and I am sure that most nurseries would be healthier by being kept cooler. I know that I shall have the cottage children held up to me as examples of the hardening system; I shall be told to observe their rosy cheeks, their sturdy limbs. As a matter of fact, I don't much believe in them. Our hospitals are full of cottage children—poor little creatures, mostly suffering from exposure and bad feeding! The reason that the strongest live is that they live in the open air, and it is a common thing to hear a poor woman say in response to your inquiry as to her children: "I've got five, ma'am; I've buried four." The largest mortality occurs in children under one year old; and in Russia, I believe, chiefly owing to the intense cold in winter, the death-rate among children is something appalling. In England infant mortality is greatest in hot summer and autumn—from diarrhœa—largely owing to badness of milk kept in dirty vessels.

In concluding this part of my paper, I may remark that a mother should remember the old proverb that prevention is better than cure, and that, by daily careful supervision of her child, she may save him from much that the unfortunate child of a careless mother has to endure, and may also console herself, when unavoidable illness comes, that she has done all that lies in her power to provide her child with health and strength to resist disease.

II.

As soon as a child is old enough to develop a will of its own, the first thing it does is to try and get its own way, and one of the earliest lessons it has to learn is that it can only have its own way when it is compatible with the comfort and rights of others; and even a mere baby will soon find out how far it may encroach on the kindness or weakness of those around it.

As we are none of us born models of virtuous behavior, some

kind of punishment must necessarily be used now and then in the nursery; but, as far as is possible, the child should be made to feel that the punishment is the natural result of his bad action, and not the mere venting of anger and annoyance on the part of the parent or nurse. If a child once finds out that certain actions always entail unpleasant consequences, he will no more think of committing them than he would think of putting his hands in the fire, which, he has early learned, has an unpleasant habit of burning. There are no better philosophers than children, who always resign themselves to the inevitable; but let the children be certain that it *is* the inevitable—let the child find out that bad behavior in the drawing-room means instant banishment to the nursery; that if he knocks his brother with a stick the result is "*no sticks*"; that if he refuses to put away his toys one night, he must manage without toys the next night, and so on.

If the mother merely talks at the child, and says, "How often must I tell you not to do so?" or, "I shall send you up-stairs," the child soon perceives that, after all, this entails no consequences, and he very wisely acts accordingly. On the other hand, nothing should be denied to a child without some reason. A great many mothers, and most nurses, bring up children on the principle contained in "Punch's" remark, so delightfully illustrated by Du Maurier: "Maud, go and see what Baby is doing, and tell him he mustn't."

With regard to corporal punishment, I think it wholly unnecessary. Even those who assert that it is good for children can not deny that it is bad for parents. No one is virtuous enough to be judge, jury, and executioner in one. And if it is harmful for a mother to treat her child like an animal, it must no less harm the child to be treated as one, and to be governed through the feelings of pain and fear, instead of the higher ones of reason and affection. But here I can not do better than quote a few passages from Locke's "Essay on Education," which I think very wise:

> The usual lazy and short way by chastisement with the rod, the only instrument of government that tutors generally know, is the most unfit of any to be used in education. For from what other motive but of sensual pleasure or pain does a child act who drudges at his book against his inclinations, or abstains from eating unwholesome fruit that he takes pleasure in only out of fear of whipping, and what is it to govern his actions and direct his conduct by such motives as these? What is it, I say, but to cherish that principle in him which it is our business to root out and destroy? And therefore I can not think any correction useful to a child where the shame of suffering for having done amiss does not work more upon him than the pain.

And again:

> I am very apt to think that great severity of punishment does but very little good, nay, great harm, in education, and I believe it will be found those children which have been most chastised seldom make the best men.

If the mind be curbed and humbled too much in children, if their spirits be abased and broken much by too strict a hand over them, they lose all their vigor and industry. For extravagant young fellows that have liveliness and spirit come sometimes to be set right, and so make able and great men. But dejected minds, timorous and tame, and low spirits, are hardly ever to be raised, and very seldom attain to anything.

Again, when a child does well, Locke advises his father and mother to show pleasure, and, upon his doing ill, to show a cold, neglectful countenance, and this, he says, "if constantly observed, I doubt not but will of itself work more than threats or blows, which lose their force when once grown common, and are of no use when shame does not attend them." With regard to the early teaching of children, it should be remembered that a young child is always learning, and therefore parents should not be in too great a hurry to begin that branch of education popularly known as "lessons"; and lessons themselves must not be looked upon as an end, but as a means, or as tools put into the hands of a child to enable him to shape his own life and discover its uses and beauty.

We do not want to manufacture little prigs, who have swallowed a mass of facts never to be digested, but we want children who can take an intelligent interest in all that is going on around them. They will learn much if their mothers will only take the trouble to answer questions in an intelligent manner: it is either laziness or stupidity to repulse a child with "Don't ask questions."

A mother who conscientiously answers questions will find that she too has profited as well as her children, and if there are some questions the right answers to which it would be impossible for children to understand, let them be told so honestly and not put off with evasive answers. Nothing is better for young children than to be sent to a good Kindergarten: they learn to be obedient when they find obedience is expected as a matter of course; they learn to be observant, which is of great use to them in after-life; and they are made to take a pleasure in all they do, as all they learn is made interesting to them. The Kindergarten principles may, however, be carried out in all home teaching, when pleasure in learning will be found one of the greatest aids to mental digestion.

I should begin the teaching of a child as a favor, not as a task; if he is inattentive, I should by no means insist upon the lesson being done, and so give it the air of a task. It is far better to say: "I really can not waste my time in teaching you. I have other matters to do, and if you can not give me a little attention you may go away." With the natural perversity of human nature, the child immediately becomes anxious to learn, and feels at once that you are doing him a favor, not he, you. If a child seems dull, never force it to learn. If the dullness proceeds from deli-

cacy, every effort should be made to strengthen the body, and definite teaching should begin later than with a robust child. It is most foolish to cram the head of a backward child with phrases it can not understand—at most it can but learn parrot-fashion, and such a proceeding is about as senseless as loading a delicate stomach with indigestible food. If a child has an appetite for its bodily food, it can digest, and the same rule holds good for mental food. There is no use in cramming it down if the appetite for knowledge be not there.

All teaching should proceed from the concrete to the abstract, though the reverse method is generally employed. Arithmetic, for instance, should at first be taught from objects, and not by names and figures which are mere symbols and abstractions, and most difficult for the minds of children to grasp. The relative value of different kinds of money may be easily learned by quite young children, merely by letting them play at shop with real money. At the same time they are unconsciously learning both addition and subtraction. Weights and measures should be learned in the same way, and they will be far better impressed on the memory than by merely learning the tables of weights and measures in an arithmetic book.

Again, with languages—rules of grammar should be learned last of all; a language is formed long before any rules for speaking it are formulated. The rules of grammar are only the recorded observations of what I may call the habits of a language. Every child should learn a new language as it learns its own, by talking it, looking at picture books and learning nursery rhymes, and the language will have some chance of developing naturally and easily, and of being retained for use in after-life. As languages are usually taught in schools, they are of no value beyond that of mental gymnastics, and when the school life is over all the rules and exercises, learned with so much weariness and disgust, slip from the memory, from having made no impression on the mind.

If the child has a natural bent in some particular direction, this should be encouraged as early as possible. I think, as a rule, children are taught far too many things. Who does not know of girls who, with no ear for music, are forced daily to undergo the drudgery of practicing, merely because it is the proper thing for girls to play, at any rate a little? Many persons will be terribly alarmed at the suggestion that science is one of those things all children should be taught. The word science suggests to them all that is dry, cold, difficult, and unromantic—why, I can not tell, for the word itself only means knowledge, and children find anything acceptable and interesting that will answer their numerous questions concerning all around them, and far from being dry and unromantic. "Science," to use the words of Mr. Herbert Spencer,

"opens up realms of poetry where to the unscientific all is a blank."

Science properly taught is most valuable to children, in that it encourages a spirit of inquiry and love of truth, and trains them in habits of accurate observance of all around them, all of which qualities must surely be of use to them. These conclusions will not, perhaps, be acceptable to those persons to whom science is represented merely by the learning by heart of a collection of arid statements: such as the distance from here to the moon—the rate at which the earth revolves on its own axis—and so on. I should certainly advise them *not* to teach their children science of this description.

Before ending my paper, I should like to say a few words with regard to what I think a great evil in the education of girls. At an age of rapid growth, a girl's health is sometimes ruined for life by the system of brain-forcing to which she is subjected. In many cases she has to work eight hours a day, which is the average number of working hours of a grown man. Examinations follow one after another, there is no time to attend to the development of the body, at the most one hour in the twenty-four is given up to a mild walk; and the continuous sitting in a stuffy room, stooping over books narrows the chest, and spoils the eye-sight; at the age of eighteen a pale, anæmic young lady emerges from the school-room, doubtless stocked with knowledge, but also with headaches and backaches enough to spoil the rest of her life.

When one considers the extraordinary rate at which a girl of fourteen will grow, and how much of her forces must be consumed in the mere act of growing, surely it seems more reasonable to lighten her work than to increase it. Such a girl should only be allowed to work in the mornings, when she is freshest, and the rest of the day should be devoted to the open air, and development of her body by healthy outdoor games. Above all, even if she has work in the afternoon—and some time must, I suppose, be allowed for preparation—no mental work of any kind should be allowed after 5 P.M. After a long day at school, many a time does the tired child return with a quantity of exercises, etc., to be prepared for the morrow, all of which must be done in the evening, and it stands to reason that it must be highly prejudicial to the brain to be taxed at a time when it is fatigued, and the physical powers of the child are at a low ebb.

In a paper entitled "Home Lessons after School Hours," sent to me by my friend Sir Joseph Fayrer, and read by him at a conference at the Health Exhibition, he points out the dangers attending the cramming system, and instances many cases of brain disease resulting from it.

In conclusion, let me say that moral development can not be

too early or carefully attended to. Morals in a child are in a very rudimentary condition, and much depends on the mother as to whether they are to develop and give strength to the character, or whether they are to wither away, like unused organs of the body. Truthfulness, courage, and unselfishness are blossoms of character growing from but small seeds; let them be nourished in the warmth and sunshine of love and sympathy, and watchfully protected from choking weeds, and at last will come the crowning of a fine character, without which all the book-learning in the world is but a parrot's jargon.—*Nineteenth Century.*

THE STRUGGLE OF SEA AND LAND.

By Dr. VINZENZ HILBER, of Graz.

WE stand on a bluff at the sea-shore. The surf is undermining it. That deep cutting into the bank is its work. An overhanging mass of earth is thrown down and becomes the toy of the waves, which reduce it to gravel. This in its turn becomes ammunition to be hurled against the shore. Wherever this process is going on, the land falls back before the advancing sea, and considerable results are evident in a short time. The Island of Heligoland has been reduced, within a thousand years, from a considerable island to a mere rock. The strings of rocky islands along many coasts are remnants of destroyed shore-land. Thus the land yields with hardly a struggle to the supremacy of the sea. Loose alluvial terrains give way in a body. The Zuyder Zee so came into being five hundred years ago, and Holland, part of which is below the level of the sea, would have been likewise overflown if it had not been defended by artificial dikes. Subsidences of ground have also been sometimes observed during earthquakes.

In other places the sea gives way. Rivers carry out masses of detritus and deposit them along the shores, causing the land to advance. By the operation of this process Roman ports on the eastern coast of Italy have been left away inland, and whole alluvial districts of the upper Italian plain have been wrested from the sea.

No doubt a very long time is required for important changes in the sea-lines to be produced by these processes; hence we must widen our view if we would find a solution of the problems which the history of the primitive seas offers us.

When the Alpine traveler finds sea-shells included in the rocks on high peaks, he says that the strata of the mountain are ocean deposits. In the great foldings of the rocks which he can follow

along the naked cliffs, he recognizes the results of mighty movements which the strata have undergone since they were formed, and will correctly ascribe their elevation to the same movements. The mountain has been produced through a doubling up caused by a sidewise pressure. If he turns his steps to the adjacent lowlands, he will make the same observation in horizontal strata. He now has his choice whether to believe in an elevation of a large part of the earth's crust, or in a sinking of the level of the sea since the crust was formed. One of the most debated questions of geology turns on this point.

The successive layers of the earth's crust have sometimes been compared to the leaves of a book. We read in them a long passage in the earth's history written by the scribe Nature herself while the events were happening, and therefore even more trustworthy than the sources of ordinary history. Yet many pages of the book are obscure, and those of the first part are still waiting to be deciphered; for, in the sparkling leaves of the archaic crystalline rocks, the letters that should give us knowledge of the beginnings of life on the earth seem to have been washed out. The first volume, telling of the Palæozoic age, makes us acquainted with a lower fauna, principally marine, from which only the vertebrates are absent. Then cartilaginous fishes appear in the Silurian and Devonian, and land-inhabiting vertebrates, amphibia, and reptiles in the Carboniferous and Permian. The development of life goes on in the Mesozoic epoch. The oldest and lowest organized mammals, the marsupials, meet us in the upper Trias. The Jurassic gives us the first birds, curious creatures with teeth in their bills and lizards' tails bearing feathers. Two specimens have been found, in the *Archæopteryx*, of the transition form between the reptile and the bird. The Cretaceous furnishes the first bony fish and new toothed birds, the odontornithides. The Cenozoic age, the fourth and last volume of the great book, exhibits another advance in the development of animal life; and in the Tertiary the forerunners of the present mammals, and in the diluvial, man, appear. A similar process of development from lower to higher forms is shown in the vegetable world.

The story of this gradual rise of more and more highly organized beings is certainly the most important content of those stone books. But, besides that, they record that the firm lands arose out of the floods, that the sea washed over the land, left it, and covered it again, while the mass of the land constantly grew. The pages that sketch the covering of a stretch of earth by the sea are fully written up; but the periods of dry land are more frequently made known by a gap than by a continuance of the relation; and, in the latter case, the terrestrial deposits are only present when the spot has been covered by a river or a lake.

According to the best established and prevailing views, the great sea-beds, the deep basins, are the original features of the "face of the earth." They are the first depressions that were made after the planet's surface was solidified and its structure began to shrink from cooling. These depressions have probably been increasing vertically through all the geological ages, and therein lies the cause of the constant increase of the land to the present time. But the constancy of this increase is a fact only as a whole; for there have been times when the sea rose over the shore and overflowed a large part of the land. The last great transgression of this kind occurred at the beginning of the Miocene Tertiary, when extensive tracts of the Old World were covered with water. Parts of Italy, Portugal, southern France, northern Switzerland, southern and northern Germany, the Vienna basin, and the Hungarian plain, and of the lowlands of eastern Europe and the Black Sea region away into the interior of Asia to Persia, with the plains of North Africa still bear the marine deposits of that period, with the remains of organisms, mostly of extinct species, that inhabited the adjoining seas. The waters retired to their beds during the Pliocene, and the present boundary-lines of the land regions, aside from a few erosions, were shaped during the same period. Similar processes took place repeatedly in the earlier periods of the earth's growth, and to them are ascribed most of the changes that have taken place in the species of animals and plants; for these encroachments of the sea forced the living world into a narrower space, and entailed a fierce struggle for existence, in which the less valiant species succumbed. The retreat of the sea again permitted a fruitful development of life and the origination of new species.

An important circumstance has been brought to light in the investigation of the fluctuations of the ocean. The continents have been overflowed several times. Suess, who has made the most thorough study of the subject, has recognized six principal periods of submersion, and as many of dryness. But no indubitably deep-sea deposits later than the Silurian are to be found on the present continents. The great sea-beds are primitive; and primitive likewise are the socles of the continents, standing as equally sturdy champions with the briny flood, sometimes in the alternations of the contest lying under it, overcome by the sea, at other times shaking it off and sending it back within its lines.

The cause of these processes is still awaiting explanation. Celsius and Linnæus, who observed the gain of land on the Baltic coast during the last century, expressed the opinion that the sea was retreating. This view was contested at the beginning of the present century by Leopold von Buch, who thought that Scandinavia was rising. Lyell and Darwin advanced the theory of the

rising and sinking of continents, and this solution of the problem has not been contradicted till very recently. There is a kind of suggestion with which great men, to whose minds the world pays deference, inspire their contemporaries when they give any view the weight of their approval, which is at the same time detrimental to progress in science. In this way many an error has been generally accepted without further proof.

Suess does not ask for an unjudicial acceptance of his theory, but has published the whole course of his investigations, with his proofs, in a great work, the "Antlitz der Erde" ("The Face of the Earth"), in which he has examined the signs of changes in the level of the ocean, so far as they have been observed in all known parts of the earth and through all the geological periods. His exposition points to a synchronism of overflows and uncoverings of the land over extensive regions. This result has impelled him to oppose the prevailing doctrine of upheavals and depressions of the land. Aside from the fact that the supposed elevation of the continents is problematical in itself, such movements could not go on over the whole earth at the same time and in the same direction. Changes in the level of the waters, on the other hand, would be of the general character which the survey of the phenomena indicates, for a free rising of the water, even under local influences, would at once make itself felt over the whole surface of the earth.

Suess's studies of the causes of the rising and falling of the waters brought him to the following conclusions: The ocean beds were produced by the sinking of those parts of the earth's surface that correspond with them. The uneven shrinking of the globe is a consequence of its continuous cooling. Every new subsidence of the sea-bottom causes a falling of the water. Elevations of the ground take place too. The bottom of the ocean is incessantly receiving detritus from the overflowed land, of which the water brings down as much as it can hold; this tends to raise the level of the ocean. Yet Suess concludes that these processes are not adequate to explain the full measure of the primitive movements, and reserves judgment on that point.

The present author has gone further into this subject, in an article in the "Zeitschrift für wissenschaftliche Geographie," although he has not concealed the existing difficulty. Unfortunately, Suess's deductions were not before him when he prepared his paper. That essay, building in part on similar researches, accepts contraction as the sufficient cause for the fluctuations of the sea. According to the now prevailing views, which have, however, been very recently contradicted by investigators of repute, the constant loss of heat from the interior of the earth produces a steady shrinkage of the globe. From time to time the tensions in

the outer arches of the earth are relaxed, and the crust sinks. In that case, three views are conceivable respecting the relations of land and sea: either both parts sink alike, or the land sinks more than the sea, or the sea than the land. In the first case, the rise of the sea will be only that caused by the contraction of its bed, which, being dependent on the slighter contraction of the surface of the globe, is of relatively little importance; in the second case, the sea would spread over the lower lands, rising to appearance, while in fact its level has diminished on account of the wider diffusion of its waters; or, in the third case, the sea would retire on account of the falling of its level.

These things alone could hardly have produced the observed results, had there not been important circumstances associated with them which in times of quiet worked in their favor. The land is being uninterruptedly swept off, and is gradually as a whole becoming lower and lower from the top. The rock falls from the heights, the brooks and rivers take fragments in their course and drag the chips of weathering and of their own planing-work into the sea. The land is reduced by denudation, the sea rises by the action of the deposits on its bottom. Extensive lowlands are at last formed as the result of the washings, so that large districts may be put under water by slight shrinkings of the land. When these are overflowed by the sea, the deposits rise on its bottom, stratum by stratum, till, after a long time, they nearly reach the level of the water. Then a slight sinking of the sea-bottom suffices to reduce the water to its old level; and the alternation of a washing away of the soil and the conversion of the overflowed territory into dry land begins anew.—*Translated for the Popular Science Monthly from Das Ausland.*

THE ROYAL SOCIETY OF ENGLAND.

By Dr. WILLIAM C. CAHALL.

THAT "wonderful pacifick year 1660" witnessed the restoration of the house of Stuart and the organization of the Royal Society.

After twenty years of civil wars, Cromwell, and Puritanism, the English people, with the surfeit which invariably follows the prolonged discussion of one idea, turned with avidity to the gay court which Charles II brought with him into Whitehall. Peace came, commerce flowed on undisturbed, and from the strictest religion the national pendulum swung to license, skepticism, and debauchery.

Fortunately, it was but a part of England which fell into these

excesses. There was an element which likewise turned from the heated discussions of theology, but, more wisely, sought the serene companionship of Nature as the restful change.

"There arose at this time," says Dr. Whewell, "a group of philosophers, who began to knock at the door where truth was to be found, although it was left for Newton to force it open. These were the founders of the Royal Society."

But to Lord Bacon, who died but thirty-six years before the incorporation of the society, is due the first impulse in England to the proper study of nature. Indeed, some such an institution as the Royal Society, for the study of the sciences, was in his mind when he wrote his philosophical romance, the "New Atlantis." What he did not live to form, his disciples realized.

Dr. Wallis, in his diary of 1696–'97, says: "About the year 1645, while I lived in London (at a time when, by our civil wars, academical studies were much interrupted in both our universities), besides the conversation of diverse eminent divines, as to matters theological, I had the opportunity of being acquainted with diverse worthy persons, inquisitive into natural philosophy and other parts of human learning, and particularly of what had been called the *New Philosophy* or *Experimental Philosophy*. . . . Our business (at these meetings, held at Gresham College) was (precluding matters of theology and statecraft) to discourse and consider of *Philosophical Enquiries*, and such as related thereto: as *Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chemicks, Mechanicks*, and *Natural Experiments*. We then discoursed of the circulation of the blood, the valves of the veins, the venæ lacteæ, the lymphatick vessels, the Copernican hypothesis, the nature of comets and new stars, the satellites of Jupiter, the oval shape of Saturn, the spots in the sun, and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the improvement of telescopes, and grinding of glasses for that purpose, the weight of air, the possibility or impossibility of vacuities, and nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of bodies and the degree of acceleration therein, and diverse other things of like nature."

These meetings were continued at Gresham College and at Oxford, whither many went with Charles I, as frequently as the exigencies of war permitted; but, with Charles II firmly seated on the throne, the fugitives returned to London, where, in 1660, the society was formally instituted, and application was made to the king to give it a corporate being and name by a royal charter.

Sir Robert Moray, the first president, brought in word from the court that "the king had been acquainted with the design of the meeting. And he did well approve of it, and would be ready

to give encouragement to it." The royal patron fulfilled his promise.

The charter of incorporation passed the great seal on the 15th of July, 1662, and was read on the 13th of August following.

Evelyn's "Diary" of this date contains this passage: "Our charter being now passed under the broad seal, constituting us a corporation, the name of Royal Society, for the improvement of natural knowledge, was this day read; and was all that was done this afternoon, being very long."

Charles affected chemistry and navigation, and, when he grew tired of his wine and his mistresses, would resort to his laboratory, and as the young rakes, who circled about him, imitated the royal exemplar's dissipations, so they frequented the scientific lectures and tried to look wise. But even Charles and his fops could not, by their attention, harm the growing sciences in the estimation of good and true men. The reason for this may be found in the recognition of the need of such a society, and the character of the men constituting it. The fame of such men as Sir Robert Moray, Boyle, Evelyn, Pepys, Wallis, Hooke, and Wren, who were among the incorporators, continues lively to this day. It may not be, as has been said, that the incorporation of the Royal Society was the only wise act of Charles II, yet it has proved itself, without a doubt, his wisest act.

It was high time that England was bestirring herself, for on every side were evidences of the pressing need of some such instigating and conserving force as the Royal Society soon became. Every intellectual center of Italy had its Academy of Science, and France already had her society for the study of literature. The origin of learned societies appears to take the same course as the order of succession of the universities. As the first university arose in Italy, so arose the first academy; then comes France, with her University of Paris and the French Academy; later, England follows close upon the heels of France, with her universities at Oxford and Cambridge, and her Royal Society. By the lapsing of the Academy del Cimento of Florence, and other Italian academies, the Royal Society of England enjoys the honor of being the oldest in consecutive history of any society in Europe which was established for the investigation and advancement of science.

There is no better illustration of the true scientific spirit of inquiry which the Royal Society at once set on foot throughout England, than its influence upon the popular superstitions of the day. The popular belief in witchcraft had, during the sixteenth and seventeenth centuries, reached the height of its frenzy.

In Germany the number of persecutions was enormous. A twentieth part of the entire population of the small district of

Lindheim fell victims in four years. In the district of Como, Switzerland, one thousand were burned in one year (1524). In France the destruction of life was equally frightful. Witch-persecutions in England came on later, but were equally ferocious.

James I wrote a treatise on "Demonology," and during the Long Parliament three thousand persons were executed by legal processes alone, not counting the victims by mobs, as a result of this witch-mania.

But, according to Hutchison, chaplain to George I, who wrote upon witchcraft, "there were but two witches executed in England after the Royal Society published their 'Transactions,' and one of these was in the year after their first publication."

And Sir Walter Scott, in his letters on "Demonology and Witchcraft," expresses his belief that the Royal Society "tended greatly to destroy the belief in witchcraft and superstition generally."

What a comment upon the value of scientific studies!

Touching for king's-evil or scrofula, which was long rife in England, was another but more harmless superstition which the Royal Society was active in destroying. Imagine the feelings of the fastidious Charles, under such ordeals as the one related of him by Aubrey in his "Miscellanies": "Arise Evans had a fungous nose, and said it was revealed to him that the king's hand would cure him: and at the first coming of King Charles II in St. James's Park he kissed the king's hand and rubbed his nose with it, which disturbed the king, but cured him."

Even with the Royal Society itself there was a lack of precision in scientific investigation. Upon the same evening that Sir Robert Moray was elected president he brought in a contribution on "A Relation concerning Barnicles," in which he relates of a visit to Scotland, where he found attached to a certain variety of trees innumerable little shells, each containing a little bird. He confesses that, while he found everything for "making up a perfect sea-fowle," he never saw any of the birds alive. "Here we have the absurd notion of the *Lepas anatifera* breeding geese, brought before the society by their president."

We find in the same minutes that "Dr. Clark was intreated to lay before the society Mr. Pellin's relation of the production of young vipers from the powder of the liver and lungs of vipers."

The Royal Society owes to the Hon. Robert Boyle more than to any other one person for its inception. A bachelor of independent fortune, he devoted his great resources, mental and material, to experimental researches, especially in relation to chemistry and of the atmosphere. An enthusiastic follower of Bacon, he believed and practiced the cherished doctrines of the great philosopher, that experiment and experiment is the only and sure method of

founding a true science. A prodigy even in childhood, having entered Eton College when but eight years of age, he further enjoyed the advantages of European travels and education. He visited Florence in 1641, and spent the winter there studying the works of Galileo. He may have caught from the words of the then blind old astronomer, as he dictated to his disciples his last work on the "Impact of Bodies," that unwavering devotion to natural science which characterized both men. Returning to England, he gathered around him a circle of congenial friends, which formed the *Invisible College*, of which he in his works so frequently makes mention, and which subsequently became the Royal Society.

He was a prolific contributor to the "Transactions," all based upon his own investigations. His improved air-pump and his experiments with it contributed largely to the knowledge of the properties of air and the character of sound, and his work, "Experiments and Considerations upon Colours," prepared the way for Newton's more elaborate work upon the same subject. It is said that Boyle in the latter part of his life was accustomed, when engaged upon any of his important experiments, to write above his street-door, "Mr. Boyle can not be spoken with to-day."

The mere enumeration of the contributions of Boyle would fill a page, but he gleaned in too many fields to thoroughly exhaust any one. By his contemporaries Boyle was considered one of the greatest natural philosophers, and if the succeeding generations failed to retain the same high estimate of his position it is because he was succeeded by some of the greatest minds in English thought. It is sufficient for one man's fame that he originated the Royal Society.

November 12, 1662.—Robert Hooke, an assistant to Boyle, was elected a Fellow. He was but twenty-seven years old, yet as the result of his innumerable experiments "facts multiplied, leading phenomena became prominent, laws began to emerge, and generalizations to commence."

Hooke was possessed of a mind inventive and mechanical to a high degree, which led him to the threshold of some of the grandest discoveries of his time. His experiments, however, like Boyle's, were too diffuse, and he repeatedly was mortified by seeing his nearly completed discoveries anticipated. Hooke was a genius, but through lack of concentration cut a sorry figure, from always being a little too late. From the controversy with Huygens in relation to the invention of the balance-spring of watches, it was shown that he was entitled to the original conception, but that its practical application as a coil belongs to Huygens.

He had a faint conception of the undulatory theory of light; he discovered the mechanical laws which govern the motions of

the heavenly bodies; and he so nearly discovered the law of gravitation that Newton was obliged to defend his claims before the Royal Society. Even in controversies such as that with Hevelius about an improvement of the telescope, where he had the best of the argument, his unmanly conduct and irascible temper destroyed all the honor he might otherwise have attained.

With a person misshapen and repulsive, with a temper as distorted as the body, miserly in his habits, and morbidly jealous of his co-laborers, Hooke's transcendent mind recalls the fable of the jewel in the frog's brain. Sir T. Molyneux, a contemporary, says, "Hooke is the most ill-natured, conceited man in the world, hated and despised by most of the Royal Society, pretending to have all other inventions, when once discovered by their authors to the world."

An ill-requited life Hooke's must have been to call forth upon his death the declaration that "society has gained more than science has lost."

August, 1663.—Charles II displays his continued interest in the society by presenting the president with the splendid mace, which has been borne, as the insignia of his office, before every president from that date to this. It is of silver, richly carved and gilded, and weighs one hundred and ninety ounces avoirdupois. With the mace is given the privilege of having two sergeants-at-mace, whose duty shall be to wait upon the president. It is borne before the president as he enters to his chair, and is placed before him upon a table during the proceedings of the meeting. When kings, princes of the blood, or distinguished ambassadors from foreign courts desire to visit the society, the president, attended by the mace and the sergeants-at-mace, meets them at the door and escorts them to a seat beside him on the dais. No meeting is legal unless held in the presence of this ensign of authority. The chief decoration of the enchased work of the mace is the thistle, the emblem of St. Andrew, who was the patron saint of the society. The anniversary meetings and election of officers were held upon St. Andrew's day, at which time the Fellows formerly wore a St. Andrew's cross in their hats. It is in the minutes of this year we find the resolution that "the president when in the chair is to be covered, notwithstanding the Fellows of the society be uncovered."

June 28, 1665.—The meetings were discontinued on account of the plague which was at that time devastating England, carrying off, from this date to the end of the year, seventy thousand persons in London alone.

On the 7th of June, 1665, Samuel Pepys for the first time saw two or three houses marked with the red cross and the words "Lord have mercy upon us!" on the doors. On the 4th of Septem-

ber he writes to Lady Carteret, "I have stayed in the city till above seventy-four hundred died in one week, and of them about six thousand of the plague, and little noise heard day or night but tolling of bells."

The meetings were renewed again March 14, 1666. As was to be expected, we find that the medical Fellows had some report to make of their studies of such a direful disease. In consideration of the present agitation of the germ theory of disease, it is interesting to find recorded that "Dr. Charlton advanced his notion concerning the vermigation of the air as the cause of the plague, first started in England by Sir George Ent, and Dr. Bacon in Rome. It had been observed that there was a kind of insect in the air, which, being put upon a man's hand, would lay eggs hardly discernible without a microscope, which eggs being for an experiment given to be snuffed up by a dog, the dog fell into a distemper, accompanied with all the symptoms of the plague."

September 5, 1666.—The journal has this passage: "The society could not meet by reason of the late dreadfull Fire in London."

The calamity of the many is often the opportunity for the few. The flames which brought such loss and suffering upon London, swept away all obstacles to the making of England's greatest architect. In the ashes of St. Paul's Wren found his opportunity and fame. Up to this time architecture had been but one of many of the studies of Sir Christopher. Even when a gentleman-commoner at Oxford he was noted for his attainments and inventions in mathematical and experimental philosophy. Mathematics, astronomy, chemistry, and anatomy shared with architecture in his attention, and such was his skill in them all that Evelyn styled him "that rare and early prodigy of universal science."

Wren was one of the founders of the Royal Society, and was at one time Professor of Astronomy at Gresham College, where the society first met. It has been justly observed that, "but for the fire, Wren might have trifled away his genius, patching the old cathedral, and perhaps adding a new wing to Whitehall." But fortunately the fire found him still young, being but thirty-three, and in the nearly threescore years still allotted him to labor, he industriously followed his chosen science. Besides fifty-odd churches, Wren designed and built the Royal Exchange, Custom-House, Royal Observatory, College of Physicians, Greenwich Hospital, Buckingham House, Marlborough House, the towers of the west front of Westminster Abbey, and many other noble structures. But the crowning work of his life was his remodeling and rebuilding St. Paul's, which is esteemed the finest specimen of its order in the world. Wren's salary as architect of this masterpiece was less than a thousand dollars per annum, for which he was not only architect but draughtsman, overseer, contractor, and audi-

tor as well, besides, as the Duchess of Marlborough observed, "his being dragged up in a basket three or four times a week to the top of the building at great hazard."

Wren was a prominent Freemason, "was for eighteen years a member of the old Lodge of St. Paul's, then held at the Goose and Gridiron, near the cathedral, now the Lodge of Antiquity; and the records of that lodge show that the maul and trowel used at the laying of the stone of St. Paul's, together with a pair of carved mahogany candlesticks, were presented by Wren, and are now in possession of that lodge."

Wren was neglected by the court in his latter days, but amends were partially made at his death by a funeral of great distinction, and an interment in his own cathedral. Over his tomb in the crypt of St. Paul's were inscribed the words, worthy of the man and the place, "*Si monumentum requiris, circumspice!*"

November 23, 1667.—At the meeting of this date there was performed an experiment such as had never before been attempted in England. The year before Dr. Wallis had reported the success of some experiments made at Oxford by Dr. Lower, "of transfusing the blood of one animal into the body of another." But now the operation was to be tested upon a human being. A poor theological student, Arthur Coga or Coyn, offered himself as the subject. The operation was performed by Dr. Lower and Dr. King without any untoward symptoms arising. Some one asked the young man afterward why the blood of a sheep, rather than that of any other animal, was used in transfusion. He replied, "Sanguis ovis symbolicam quandam facultatem habet cum sanguine christi, quia Christus est Agnus Dei."

Harvey's discovery of the circulation of the blood, though for some time strenuously opposed, finally became accepted, and at once gave rise to the wildest speculations. In the blood were supposed to lie all the ills and diseases which tormented human life, and for their cure the bad blood had only to be drawn off, to be replaced by the pure blood of some young, healthy animal, when the sick would be restored, the maniac would recover his reason, old age return to youth again, and man become immortal.

Transfusion became the topic of the day. The courtier, the peasant, the man of science, followed every experiment with intense interest. It was a subject which appealed to the imagination and interest of every individual. If one may not secure immortality one way, may he not in another?

It is to the credit of the medical profession that as a body it deprecated the indiscriminate practice of such a hazardous experiment. There is no telling where the delirium may have carried the practice had not among the first cases occurred two deaths in

Paris, when it was prohibited in France except by the approbation of the Faculty of Paris, and later occurred two deaths in Rome, whereupon the Pope issued an edict forbidding transfusion within his domains.

December 21, 1671.—The minutes contain this sentence: "The Lord Bishop of Sarum (Dr. Seth Ward) proposed for candidate Mr. Isaac Newton, Professor of the Mathematicks at Cambridge." At this same meeting was shown a reflecting telescope made by Newton to overcome the objections hitherto pertaining to the refracting telescope. Upon receiving the society's hearty congratulations upon his invention, Newton promised to send the philosophical experiments which led to its construction. This promise he fulfilled, and the result was his famous work on "Optics." Newton now was fully launched upon that career as investigator and discoverer which has covered his name with immortal renown. He was yet scarcely thirty years of age. But even as a boy he had displayed an earnest of his future work by constructing windmills, water-clocks, and sun-dials; one of the latter is said to still mark the hours upon the walls of his old manor-house at Woolsthorpe, Lincolnshire; when only twenty-three he discovered his method of fluxions, by means of which the calculations of the movements of the planets were greatly facilitated, and he already was in possession of the principle of gravitation, which saw light sixteen years later, only because an erroneous estimate of the earth's diameter, which was a factor in his calculations, produced some inexplicable deviation from the result expected.

Newton, like Boyle, never married, but devoted his long life entirely to scientific and philosophical studies. Newton was elected President of the Royal Society in 1703, and successively re-elected until his death in 1727, thus making his presidency exceed that of any other, excepting Sir Joseph Banks, in the history of the society. This honor was not unfittingly bestowed, for there is no other name, in the long list of distinguished Fellows, whose life-work has reflected greater honor upon this already famous society.

In 1675 the Royal Society appealed to the king to establish an astronomical observatory for the study of astronomy and navigation. This the king consented to do, and commissioned Sir Christopher Wren to erect such a building at Greenwich. The Royal Society was given general supervision over its investigations, and evinced its solicitude by furnishing all the instruments used at the observatory during the first fifteen years.

Under Flamsteed as the first astronomical observator, or astronomer royal as the office was afterward called, and Halley as his successor, there began the long and unbroken series of impor-

tant observations which have made the Observatory of Greenwich the most famous in the world. When, in 1698, Peter the Great visited England, he showed his great natural love for all that bore upon navigation by spending considerable time in the observatory and among the Fellows of the Royal Society. His quick mind evidently saw the advantages of such a society and observatory, for later in his life he established the Academy of Sciences and the National Observatory at St. Petersburg.

In 1695 Dr. Woodward, Fellow, brought forward his "Essay towards a Natural History of the Earth," which secured considerable notice from the great knowledge displayed upon geological subjects. He founded the professorship of Geology at Cambridge, and bequeathed his geological museum to the university at his death. In 1710 he managed to insult Sir Hans Sloane, then president of the society, for which the society demanded an apology. This he refused to give, and was expelled. He appealed to law for reinstatement, but failed. So ended the first quarrel in the history of the society. Woodward must have had a testy temper, for he had a quarrel with Dr. Mead over some medical topic about which they disagreed, and which resulted in a duel under the gate of Gresham College. During the duel Woodward's foot slipped and he fell. "Take your life!" exclaimed Dr. Mead. "Anything but your physic," replied Woodward.

1709 is the date of the death of Sir Godfrey Copley, Fellow, and the foundation by his will of the medal of that name, which has been so pertinently styled by Sir Humphry Davy "the ancient olive crown of the Royal Society." This medal is awarded yearly "to the living author (native or foreign) of such philosophical research, either published or communicated to the society, as may appear to the council to be deserving that honor," and many of the brightest men of science throughout the world have been recipients of this medal.

In 1752 England officially changed the calendar, the Royal Society, as would be supposed, being chiefly instrumental in the change. The bill was drawn up by president of the society Folkes, the secretary, Duval, and Astronomer Royal Bradley.

The Julian calendar, as instituted by Julius Cæsar, was so perfect that it was universally used until the sixteenth century. But as time ran on it was seen that the Julian year was eleven minutes longer than it should be, so that by 1582 there was a discrepancy of ten days. This resulted in great confusion in the Church, respecting the proper dating of Easter and all other movable feasts. Pope Gregory XIII set to work to correct this, and, by the recommendation of Lilius, a Neapolitan astronomer, proposed the *Gregorian Calendar* or *New Style*, in which he corrected the excessive ten days by declaring that the day following the 5th of

October, 1582, should be called the 15th, and, to correct the annual gain of eleven minutes, that every hundredth year should not be called a leap-year, excepting every four hundredth, beginning with the year 2000. All the Catholic powers immediately adopted the Pope's brief, but the Protestant countries, in their intense hatred of all that pertained to popery, refused to accept for a long time this evidently superior calendar. It was nearly two centuries before England accepted the New Style, and was the last of the European governments to surrender, except Russia, which clings to the Old Style to this day. Late as it was, the Royal Society, for recommending the change, shared in the opprobrium which fell upon the ministry who adopted it.

Whenever the prime minister appeared in public, mobs surrounded his carriage, demanding that he restore the days by which they supposed he had shortened their lives. When Astronomer Royal Bradley took sick and died amid the popular excitement, his death was believed to be a judgment of Heaven. This popular indignation extended even to the second generation; for when the son of Lord Macclesfield was standing for Parliament in the county of Oxford, the rabble greeted his appearance with the taunting words: "Give us back, you rascal, those eleven days which your father stole from us!"

In 1753 Franklin's electrical experiments won for him the Copley medal, a rare prize for one who was not a member of the Royal Society. In 1756 he enjoyed the further distinction of being elected Fellow, without having previously requested a member to propose his name, which had been the almost invariable custom and rule. Forasmuch as the society had elected Franklin without any advance on his part, it was considered but a graceful thing for it to release him from all annual dues, which was done. Franklin, on his part, fully repaid the society for its favors by frequently contributing to its "Transactions." When medals and honorary memberships in all the learned societies had been conferred upon him, when he had become the most talked-of and courted scientist in Europe, when his attentions conferred rather than received honors, even during the period of the Revolutionary War, Franklin kept up his friendly correspondence with members of the Royal Society, and the society rendered itself worthy of grateful remembrance by every American in its brave stand against lending itself to a narrow-minded sovereign to break down Franklin's scientific reputation.

Franklin's electrical experiments had led to his discovery of lightning-rods, of the power of rods and points to carry off safely the electrical shock. The accuracy of his experiments was generally conceded, but Abbé Nollet, in France, opposed the points and declared that the rods should be blunt. A Mr. Wilson raised the

same objections in England. The question, which at other times would have been decided in scientific circles, became a political one. George III, in his eagerness to weaken Franklin's prestige, decided the scientific question like a king, adopted Wilson's views, and had blunt rods erected upon his palace. The Royal Society was appealed to. It emphatically declared for *pointed rods*. The president of the society, Sir John Pringle, was sent for, and royally commanded to support Wilson in the meetings. Sir John remonstrated: "Sire, I can not reverse the laws and operations of nature." George III modestly suggested, "Perhaps, Sir John, you had better resign."

Franklin's ready wit seized this incident to spit the king upon the point of this epigram:

"While you, great George, for knowledge hunt,
And sharp conductors change for blunt,
The nation's out of joint;
Franklin a wiser course pursues,
And all your thunder useless views,
By keeping to the *point*."

When Halley predicted the transit of Venus in 1761, the Royal Society recommended the Government to send out capable men to India to make careful observations of this important astronomical event. For this purpose Mason and Dixon, two eminent astronomers and mathematicians, were dispatched, with all necessary apparatus, upon the Government vessel Sea-Horse, to Bencoolen.

An encounter with a French frigate drove the expedition into a friendly port. The astronomers proved poor soldiers, and they wrote home to have themselves released from the hazardous undertaking.

Their apparatus was better fitted for dealing with whirling bodies at a distance rather than at close range. However, the English Government commanded them to sail, which they with much trepidation proceeded to do, although the time wasted prevented them from reaching Bencoolen. They consequently landed at the Cape of Good Hope and made their observations there.

Mason and Dixon were later associated in an expedition which proved more successful. They landed in Philadelphia in 1763, and proceeded to survey, and settle for all time, the disputed boundary-line between the colonial patents of the Penns and Lord Baltimore. This line afterward became famous in American history from its division of the free and the slave States of the Union.

It is sad to relate that the society which could stand so bravely beside a non-resident member should so weakly yield to popular clamor as to break the last tie which held one of its most distin-

guished resident members to his country and home. It but illustrates the instability of human nature to find the Royal Society refuse to be used in the slightest manner to punish Franklin, who represented the bitterest hostility to George III and his ministry, and only a few years later demand the resignation of Dr. Joseph Priestley, who simply differed with the Established Church by demanding freedom of worship, and who differed with the Government by expressing sympathy for the American colonies and for the struggling French Republic. It counted little for Priestley that he had received the Copley medal for his electrical investigations and made it possible for chemistry to become a science by his discovery of oxygen. Priestley was a Non-conformist minister, and rendered himself intensely unpopular by continual debates with the Established clergy. His controversy with Dr. (afterward Bishop) Horsley was the most important theological controversy in the eighteenth century. In view of the invariable preferment given to Dr. Horsley and other opponents for their energy displayed in these contests, Priestley was led to make the stinging comment that he appointed the bishops of England. Hated and feared by the Established Church for his undoubted abilities and heresies, hated and feared by the Government for his dangerous political heresies, no protection was granted him when, upon the anniversary of the fall of the Bastile, a mob burned to the ground his house, with all his manuscripts and apparatus, and to escape personal violence the now old man fled for refuge to America, where he spent the remainder of his life.

In 1779 Count Rumford, adventurer, soldier, and scientist, was elected Fellow. Sir Benjamin Thompson's life reads like a romance. A poor New England lad, he at the outbreak of the Revolution sailed to England, where he spent the greater part of his life. He held many positions of honor and trust, both in England and Bavaria, and displayed marked ability as a statesman and as a general. But he is chiefly remembered for his scientific attainments. He founded the Rumford medal of the Royal Society, and enjoyed the unique distinction of being its first recipient. In 1802 the society decided that the medal be given "to Benjamin Count Rumford for his various discoveries on the subject of heat and light." Rumford founded the Royal Institute, at London, for the study of these subjects, and many of England's greatest chemists and physicists have lectured here under its auspices.

Various papers upon physical optics were read before the society by Dr. Thomas Young, during 1801–'3, containing his newly discovered law of interference of light, which led to the establishment of the undulatory theory of light. This discovery placed Young in the front rank of the natural philosophers of his day,

but, as it often happens, his discovery was neglected in his own country until taken up and adopted abroad. Young was elected Fellow as soon as he reached his twenty-first year, which confirms to a certain extent the stories of his remarkable youthful attainments.

Besides being an eminent physician and writer on medical subjects, he delivered a course of philosophical lectures, served on the Board of Longitude, edited the "Nautical Almanac," and, most important of all, prosecuted his profound studies upon the Egyptian hieroglyphics, which led in 1818 to the successful interpretation of these hitherto sealed histories.

1806 is the date of the Bakerian lecture before the Royal Society, "On Some Chemical Agencies in Electricity," by Sir Humphry Davy, then but twenty-eight years old, but already the best-known chemist of his day. This brilliant memoir produced a profound sensation, and his lecture-room at the Royal Institute became a fashionable resort. Its scientific import was at once recognized over all Europe.

Although England and France were at war, the Institute of France awarded Davy the handsome prize of three thousand francs, offered by Bonaparte for the experiments best calculated to promote science; and when, a few years later, Napoleon allowed him to travel through France, the Institute elected him corresponding member of the first class. Upon his return to England, in 1815, Sir Humphry began his memorable investigation upon fire-damp, which had caused such havoc to life by explosions in the coal-mines.

As the outcome of his experiments was the invention of the safety-lamp known by his name, one of the many beneficent contributions which science is constantly conferring upon humanity. Davy deliberately refused to gain the fortune which its invention would surely have brought him, but the coal-miners showed their gratitude by presenting him with a handsome service of plate, and the Government conferred a baronetcy upon him. He received all the honors of the Royal Society, the Copley, the Royal and the Rumford medals, and was president of the society for a number of years. Sir Humphry was a highly imaginative, poetical writer, and a consummate scientific lecturer, but his presidency of the society was not among his most successful acts. After he had become famous, wealthy, and courted, he became arrogant and haughty, and, forgetful of his own lowly origin, talked much of aristocracy and high connections; so that, when he died, many recalled the epigram pronounced upon poor Hooke. Davy kept up the custom of his predecessor in office, Sir Joseph Banks, by appearing in a full court-dress when presiding over the transactions of the society. Withal, his presidency was a brilliant one,

for among the contributing members during his term of office were Herschel, Buckland, Young, Dalton, Babbage, Brewster, and Faraday.

King George IV, in 1825, showed his interest in the Royal Society by proposing to award two gold medals, to be known as the Royal medals. The society accepted the proposal, and in the following year the first prize was bestowed upon John Dalton, of Manchester, "for the development of the chemical theory of definite proportions, usually called the atomic theory, and for his labors and discoveries in physical and chemical science."

The laws enunciated by Dalton upon the atomic theory are the greatest generalizations in chemistry, and at once placed it among the exact sciences. Dalton had an analytical, experimental turn of mind; patient, persevering, and painstaking, supreme in the laboratory, but almost destitute of social and literary instincts. When asked why he did not marry, he replied that he never had the time. One who had not time to seek a wife would not likely have the time nor the desire to seek general culture. So we are not surprised to hear him say that his entire library could be carried upon his back, and scarcely half of these had he read.

Dalton always wore the plain, colorless garb of the Friends, and only once appeared in public otherwise. When he was in London in 1834 his friends desired to present him to the king, but he refused to invest himself in the court-dress. He went arrayed in the scarlet doctor's robe, perfectly unconscious of the brilliancy of his attire; he was a victim of his friends' innocent conspiracy, for Dalton was color-blind.

In 1864 the Royal Society, through its president, Major-General Sabine, awarded the Copley medal to Charles Darwin, the author of the "Origin of Species." The president highly eulogized the merits of his works, "stamped throughout with the impress of the closest attention to minute details and accuracy of observation, combined with large powers of generalization." In 1839, upon his return from his voyage on the Beagle, the young naturalist, for his excellent papers on volcanic phenomena, was elected Fellow of the Royal Society, and at the anniversary meeting of the society in November, 1853, the Royal medal was presented him for his masterly treatise on "Coral Reefs." So, when the "Origin of Species" appeared, it was not from an unknown author, but one who had already attained a world-wide reputation. But no man's reputation, however great, could have saved so revolutionary a work as the "Origin" from the most violent opposition. It called forth grave reviews, satires, wit, even personal vituperation; but Darwin, in his rural home in Kent, received it all in a philosophic spirit, and abided his time. The "Origin of

Species" was the launching of the evolutionary movement, and, without discussing the validity of the doctrine, it is safe to say that it has given rise to the most forcible and puissant school of philosophy of the present day, and has affected science, in its myriad branches, more profoundly than any other scientific generalization since Newton's conception of the pervading force of gravitation.

During the early existence of the society the meetings were held in Gresham College, where many of its members were professors. In 1710 the society removed to Crane Court. In 1780 the president, Sir Joseph Banks, was instrumental in securing from the Government more comfortable accommodations in Somerset House. Their present location is at Burlington House, whither they moved in 1857. The meetings are held every Thursday at 4.30 P. M., from November to June; and of the communications read before the society, a "Committee of Papers" selects the most noteworthy for publication in the "Philosophical Transactions" or the "Proceedings of the Royal Society." Since the presidency of Sir Joseph Banks, membership in the society has been much more difficult to attain than formerly, from the great number of applicants for the limited vacancies to be filled each year. Each application for membership must be signed by six Fellows, three of whom must be personally acquainted with the applicant. From a list of such applicants, as it is often a long one, the Council of the society on the first Thursday of June each year selects fifteen by ballot, which selection is usually ratified by the society without change.

There is a corresponding class of foreign members, fifty in number, which includes the names of the foremost scientists throughout the world. No scientist is so eminent but feels honored by being elected Fellow of this ancient corporation, and to have one's labors crowned by one of its medals is a mark of the highest distinction.

THE luminous night-clouds which have been seen in Europe, at about the time of the summer solstice, since 1885, are mentioned by Herr Jesse as important subjects for accurate study. The author believes that they are interesting from an astronomical as well as meteorological point of view, because their periodic movement, taken in connection with their extraordinary height, suggests that they manifest the activity of cosmical forces. He holds, therefore, that they may throw some light upon the question whether cosmical space is filled with a resisting medium. Some other observers believe that the luminosity is a reflection from the very high solstitial sun. Herr Stubenrauch, meteorological observer at Punta Arenas, South America, informs Herr Jesse that he saw the phenomenon twice there in December, 1888—also near the summer solstice of his place of observation.

SPEECH AND SONG.

By Sir MORELL MACKENZIE.

PART II.—SONG.

HAVING dealt in a previous article (see "Popular Science Monthly" for November, 1889) with the voice in its every-day garb of speech, it now remains for me to speak of it as it is when transfigured in song. The organ is the same in both cases, but in song it is used strictly as a musical instrument—one, too, of far more complex structure than any fashioned by the hand of man. The mechanism of voice has already been described, but, for the sake of clearness, it may be well to recall the three essential elements in its production: 1, the air-blast, or motive power; 2, the vibrating reed, or tone-producing apparatus; 3, the sounding-board, or re-enforcing cavities. These, to parody a well-worn physiological metaphor, are the three legs of the tripod of voice; defect in, or mismanagement of, any one of them is fatal to the musical efficiency of the vocal instrument. The air supplied by the lungs is molded into sound by the innumerable nimble little fingers of the muscles which move the vocal cords. These fingers (which prosaic anatomists call *fibers*), besides being almost countless in number, are arranged in so intricate a manner that every one who dissects them finds out something new, which, it is needless to say, is forthwith given to the world as an important discovery. It is probable that no amount of macerating or teasing out with pincers will ever bring us to "finality" in this matter; nor do I think it would profit us much as regards our knowledge of the physiology of the voice if the last tiny fibrilla of muscle were run to earth. The mind can form no clearer notions of the infinitely little than of the infinitely great, and the microscopic movements of these tiny strips of contractile tissue would be no more *real* to us than the figures which express the rapidity of light and the vast stretches of astronomical time and distance. Moreover, no two persons have their laryngeal muscles arranged in precisely the same manner, a circumstance which of itself goes a considerable way toward explaining the almost infinite variety of human voices. The wonderful diversity of expression in faces which structurally, as we may say, are almost identical, is due to minute differences in the arrangement of the little muscles which move the skin. The same thing holds good of the larynx. In addition to this there are more appreciable differences, such as we see in the other parts of the body. The larynx itself is as various in size and shape as the nose; and this is still more the case with the other parts concerned in the production of the voice. The most laborious ana-

tomical Gradgrind would shrink appalled from the attempt to measure the capacity and trace the shape of the various resonance chambers—chest, throat, mouth, and nose, with the many intricate little passages and cave-like spaces communicating with the latter—yet the slightest difference in the form, size, or material structure of any of these parts must have its effect in modifying the voice to some extent.

It is a curious fact that singers, who are often rather unwilling to believe that the voice is formed solely in the larynx, are yet generally surprised to be told that the true nature of the voice can not be certainly determined by examination of that organ. From what has been said as to the extraordinary number of the component parts of the vocal machine, it will be evident that it would be almost as rash to pronounce on the nature of the voice from the appearance of the larynx as it would be to take the shape of the nose as an index of moral character. It can only be said in a general way that, other things (notably, the resonance chambers) being equal, one expects a large, roomy larynx, with thick, powerful cords, to yield a deep, massive voice, and a small organ, with slender cords, to send forth a shrill, high-pitched voice. These two types represent the male and female voice respectively; that of the child belongs to the latter category. It must be understood that the difference in size between the largest larynx and the smallest is, after all, very trifling in itself. For instance, the vocal cords in women are but a fraction of an inch shorter than in men, and the other dimensions vary in much the same proportion. A like difference prevails throughout the resonant apparatus, the reenforcing chambers being larger in men, and their walls (which are built up of bone, gristle, and muscle) denser and more solid.

The voice varies in compass no less than in quality. *A priori* long vocal cords should indicate great range of tone, but so much depends on the management of these vibrating reeds that comparatively little significance can be attached to mere length. The average compass of the singing voice is from two to three octaves, the latter limit being seldom exceeded. The artistic effect produced with this small stock of available notes is as wonderful in its way as the marvelous results that can be got out of the twenty-six letters of the alphabet. In singing up the scale, the vocalist feels that at a certain point he has to alter his method of production in order to reach the higher notes. This point marks the breaks between the so-called "chest" and "head" registers, or what I may call the lower and upper stories of the voice.

The subject of the registers has been much debated by the learned, and still more perhaps by the unlearned; it is the "Eastern question" of vocal physiology. Quite a considerable literature has gathered round it; philosophers have lost their tempers

and musicians have shown a plentiful lack of harmony in discussing it. The inherent difficulties of the subject have been increased by the fantastic terminology which has come down to us from a pre-scientific age, and by the erroneous observations of incompetent persons. I can touch only very lightly on the subject here, but those who wish for a full exposition of my views on the matter may be referred to a little work which I published some years ago, and which has been translated into eight languages.* It may be asked, What is a register? The best definition I can offer is that it is a series of tones of like quality produced by a particular adjustment of the vocal cords to receive the air-blast from the lungs. The question is what the "particular adjustment" is in each case. The first step toward clearing up the subject is to discard the terms "chest" and "head" voice, which are meaningless and often misleading. Whatever number of registers there may be, and however they may be produced, it is certain that the change of mechanism takes place only in the larynx. I have suggested that the terms "long reed" and "short reed" register should be used to designate the two fundamental divisions of the human voice. In the former, usually called "chest voice," the vocal cords vibrate in their whole length, and the sounds are re-enforced largely by the cavity of the chest, the walls of which can be felt to vibrate strongly when this register is used. In the latter, "head voice," or falsetto, only a part of the cord vibrates, and the sound is re-enforced by the upper resonators, mouth, bony cavities of the skull, etc. It is this which has given rise to the absurd statements of singers that they could *feel* their head notes coming from the back of the nose, the forehead, etc. In the "long reed" register the pitch is raised by increasing tension of the vibrating element; in the "short reed" register by gradual shortening of it. This is effected by a curious process, which can be distinctly seen in the living throat with the laryngoscope. The two cords are forced against each other at their hinder part with such force as to stop each other's movement. While the notes of the chest register issue from the natural aperture of the larynx, the head notes come through an artificially diminished orifice, the chink becoming gradually smaller till there is nothing left to vibrate, when the limit of the voice is reached. The two registers generally overlap for a greater or less extent, a few notes about the middle of the voice being capable of being sung in either. Some voices have no break in their entire compass, the same mechanism being used throughout, but this is very rare. It was the constant aim of the famous old Italian singing-masters to *unite* the two natural registers so perfectly that no break should be perceptible.

Till a comparatively recent date the generally received explana-

*"Hygiene of the Vocal Organs," Macmillan & Co., sixth edition, 1888.

tion of the registers was that, while in the delivery of chest notes the whole substance of the vocal cord vibrated, in the "head" voice only its thin inner margin did so; in both cases the entire *length* of the cord was supposed to vibrate. The shortening of the vibrating reed, however, by the mutual "stopping" process mentioned above, is not a theory, but a *fact* which can be seen. I am inclined to believe, however, that under certain circumstances the two processes of shortening and marginal vibration may be combined. This may possibly be the true mechanism of the falsetto voice, as to which there has been so much dispute. It is clear that the term has been used by different persons in different senses, and much of the confusion which exists on the subject is, in my opinion, due to this cause. By most of the old Italian writers, the term falsetto is used as synonymous with head voice; by others it is employed to denote that kind of voice "whereby a man going beyond the upper limit of his natural voice counterfeits that of a woman" (Rousseau, "Dictionnaire de Musique"). A similar difference of opinion exists as to the beauty of falsetto, some speaking rapturously of its flute-like softness, others reviling it as "the most disagreeable of all *timbres* of the human voice" (Rousseau, ibid.). I venture with all humility to submit that "falsetto" and "head voice" should not be used interchangeably. The "long reed" and "short reed" registers are used alike by the two sexes, the greater part of the male voice, however, belonging to the former, and the greater part of the female to the latter. The term "falsetto" should be reserved for the artificial method of delivery, by which the limited "short reed" register in men is forced upward beyond its natural compass. In this mode of production the air is blown up from the lungs so gently that it has not sufficient power to throw the whole thickness of the vocal cord into vibration. This accounts for the soft, "flute-like" tones which are characteristic of the falsetto voice.

To sum up the mechanism of the registers, there is first the "long reed" or "chest" register, in which the cords vibrate in their whole length and thickness; then the "short reed" or "head" register, in which the vibrating reed is gradually shortened; lastly, the falsetto, which belongs to men alone, and is formed by the vibration of the margins only of the shortened reeds. Pitch rises in the long reed register owing to increasing tension of the cords, accompanied by increasing rapidity of vibration; when the cord can not be made more tense, the device of shortening the reed is brought into play. In the upper register not only is the aperture between the cords ("glottis") diminished to the smallest possible size, but the whole upper orifice of the larynx is compressed from side to side, so as to leave only a very narrow chink for the voice to pass through. In the lower register, on the other hand, the

larynx is wide open, and the vibrating air rushes forth in a full, broad stream of sound.

Many singing-masters, not content with the great natural divisions of the voice which have just been indicated, insist that there are five different registers, each with a distinct mechanism of its own. I am not a *maestro*, and therefore I am willing to admit that, artistically speaking, there *ought* to be five registers, or, in fact, any number of them that may be thought desirable. But if that is a necessity of art, it is not a necessity of Nature, which does all that is required by the simple process which has been described. The differences of mechanism on which the singing-masters profess to base their division are mostly of so subtle a nature as to be almost invisible to the eye, and sometimes even hardly appreciable by the ordinary intellect. I think, however, there is a way of reconciling their views with mine, diametrically opposed as they at first sight seem to be. As a physiologist, I speak solely of the tone of a note, that is to say, of its place in the musical scale, and I say, That note is delivered by the long reed or short reed adjustment, as the case may be; as musicians, on the other hand, the *maestri*, speaking of the quality as well as the tone, say, That note ought to be delivered in such and such a way to make it artistically beautiful. In the one case, in short, the voice is considered purely as it is produced in the larynx; in the other, as it is delivered by a well-trained singer managing his resonance apparatus to the best advantage. Now, for this result many things are needed besides the correct adjustment of the vocal cords. The supply of breath must be regulated to a nicety, and the position of the tongue, soft palate, cheeks, and lips must be precisely that which is best for the utterance of each particular note. There are rules founded on experience which govern all these things; these rules are expressed in terms of subjective sensations, which are scientifically absurd, but, at the same time, may be practically useful, as indicating the feelings that should accompany the right performance of the manœuvre required. It is on all this complicated mechanism that the five registers of the singing-masters are based; the more or less fanciful changes in the larynx, to which they attribute the slight, but artistically vital, differences in production which their trained ear enables them to appreciate, have in reality but little share in the result. The difference between artistic and inartistic production of the voice depends far more on the management of the resonators than on the adjustment of the vocal cords.

This point will be better understood if it is borne in mind that, as Helmholtz has shown, every musical sound is "compounded of many simples"; that is to say, the fundamental tone is re-enforced by a number of secondary sounds or "harmonics" which accom-

pany, and as it were echo, it in a higher key, the whole being blended into one sensation to the ear. Then, again, it is well known that every resonance cavity has what may be called an "elective affinity" for one particular note, to the vibrations of which it responds sympathetically, like a lover's heart answering that of his beloved. As the crude note issues from the larynx, the mouth, tongue, and soft palate mold themselves by the most delicately adapted movements into every conceivable variety of shape, clothing the raw bones of sound with body and living richness of tone. Each of the various resonance chambers re-echoes its corresponding tone, so that a single well-delivered note is in reality a full choir of harmonious sounds.

It has further been proved that each vowel has its own special pitch, and hence it can not be sounded in perfection on any other. The different vowels, in fact, are produced by modifications in the length and shape of the cavity of the mouth, and the note of each one of them is that to which such a resonance chamber naturally responds. It follows from this that, in order to get the best effect from the vocal instrument, there should be the most perfect possible adaptation of the various vowels to the notes on which they are to be sung. Sounds like *o* and *ou* (*oo*) are best rendered in the lower notes of the voice; *a* and *i* (*ee*) in the upper. It is difficult, indeed almost impossible, to sing the latter vowels on deep notes. The marriage of music to immortal verse can not be perfect unless the various affinities of the vowel sounds are carefully respected by the composer.

From what has been said it will, I think, be evident that no one, however happily gifted in point of voice, can use his endowment to the best advantage without careful training. Every note requires for its artistic production, not only a particular adjustment of the larynx, but a special arrangement of the resonators and suitable management of the breath, all the complicated movements involved in these various proceedings having to be performed automatically and with the most exact precision, and the whole being combined into one instantaneous act. M. Jourdain's master was not such a fool as he is made to appear, when he insisted on the mechanism of utterance being clearly understood. When this has been acquired, the singer is still only like a child that has learned to stand; walking, running, and dancing, in other words the junction of the separate notes into the "linked sweetness" of an air, the graces and ornaments of vocalization, and the secret of sympathetic expression have yet to be acquired. There is an unfortunate tendency at the present day to be satisfied with a very inadequate amount of training, and I can not help thinking that this is partly due to an imperfect appreciation of its necessity. Years are ungrudgingly given to acquiring a mas-

tery of the piano or violin, and it is recognized that to excel with either of these instruments seven or eight hours of laborious practice every day are necessary. Yet many seem to fancy that the voice can be trained in a few months. How preposterous such a notion is must be evident to any one who takes the trouble to think about the matter. In the case of the violin or piano the instrument is perfect from the outset, and the student has only to learn to play it; the singer, on the other hand, has to develop—in some cases almost to create—his instrument, and then to master the *technique* of it. The human larynx is, as already said, a musical instrument of the most complicated kind, for its two reeds are susceptible of almost infinite modification in size, shape, manner of vibration, etc. A distinguished surgeon not long ago edified the public by a calculation of the number of muscular movements executed by a young lady while performing a simple piece on the piano; it would be hopelessly impossible to count the movements of the muscles which work the vocal cords.

The details of vocal training I must leave to the singing-masters; I can only touch on one or two points which lie more or less within my own province. In the first place, the vocal organs must be strengthened and developed by exercise. The excellent maxim, *Memoria excolendo augetur*, which we learned from the Latin grammar, is equally true of muscle, and a singer's thyro-arytænoidei should be in as good condition as a pugilist's biceps. Such modes of life as are good for the general health will also help to improve the voice by expanding the chest and keeping all the organs at their maximum of efficiency. In order to "know the stops" of the vocal instrument, so as to be able to "command it to any utterance of harmony," training must be directed to each of the three factors of voice. The art of so governing the breath that not a particle of it shall escape without giving up its mechanical equivalent of sound must first of all be acquired. The vocal cords must use the breath as Jacob did the angel with whom he wrestled; they must not suffer it to depart till it has blessed them. The first thing the singer has to do is to learn to breathe; he must fill his lungs without gasping, and empty them quickly or slowly, gently or with violence, according to his needs. Much has been written on this matter with which I need not perplex the reader. The problem is how the lungs can be replenished most advantageously for the purposes of the singer. The chest is expanded by pulling up the ribs, and by pushing down the diaphragm, or muscular partition which separates the chest from the abdomen. In violent inspiratory effort the collar-bone may be forcibly drawn up by the muscles attached to it, but this mechanism is seldom brought into play except in the dire struggle for breath when suffocation is impending. It is a curious fact that

men breathe differently from women, the former using the abdominal method—that is, pushing down the diaphragm—and the latter doing most of the work with their upper ribs. One reason of this difference is that the fair sex insist on fixing their lower ribs, to which the diaphragm is attached, with stays, which make free movement of that muscle impossible. Doctors have fulminated against tight-lacing for the last three centuries,* but to as little purpose as the Archbishop of Rheims thundered against the jackdaw. Fashion must be obeyed, whatever its victims may have to suffer. It is right to state, however, that stays not long ago found a champion in no less a person than the Professor of Pathology in the University of Cambridge. Professor Roy caused a little mild scandal at the last meeting of the British Association by urging that the use of stays might have certain advantages. If the Archbishop of Canterbury had stood up in Convocation and denied the efficacy of baptism, he could not have shocked his hearers more than Dr. Roy did by such a profession of heresy. The scientific ladies, who resemble the Greek statues in the looseness of their waists if in nothing else, groaned over this backsliding in high places, and their more frivolous sisters rejoiced. A Defender of the Faith, however, opportunely appeared in the person of Dr. Garson, who at once put the question to the touch by measurements made on a number of ladies and gentlemen then present. These showed that the vital capacity (which is measured by the quantity of air that can be expelled from the lungs after the deepest possible inspiration) was considerably greater in the men than in the women, and that while in the former there was a constant diminution in the vital capacity in every period of ten years after the age of thirty, in the latter it actually increased after fifty, a time of life at which the majority of ladies begin to think more of comfort than of restraining the exuberance of their "figure." The truth appears to be, however, that the slight pressure exercised by stays does not matter in the case of ladies who are not called upon to use their voices professionally, and who do not care to excel as amateurs. In the ordinary work of life stays do not cause any inconvenience, and it is only when they are absurdly tight that they do serious harm to the internal organs. In the case of the *artiste* it is quite otherwise; here anything which

* Stays are generally said to have been introduced by Catherine de Medicis, who may be supposed to have had a natural genius for the invention of instruments of torture. They were, however, in use long before her time. I have in my possession a drawing made for me in 1884 by Mr. Lewis Wingfield from a MS. in the British Museum of the date 1043. It is figured by Strutt, who calls it "A Droll Devil." Mr. Wingfield more aptly terms it the "Fiend of Fashion." It represents a figure fantastically dressed in what, I suppose, was the height of fashion of the day. Its special interest in connection with the present subject is that it wears a pair of stays, laced up in front, and of sufficient constrictive power to please a modern *mondaine*.

in the smallest degree diminishes the vital capacity seriously handicaps the singer.

Although the abdominal mode of breathing may be the *natural* method of inspiration, there can, I think, be no doubt that in singing it is not the most effective. On this point the empirical traditions of singing-masters were abandoned some years ago in favor of what was supposed to be the teaching of science, and now singers are often taught to breathe by pushing down the diaphragm and protruding the stomach. Anatomists are, however, beginning to see that the Italian masters were right in insisting that the diaphragm should be fixed, and the abdomen flat in inspiration; in this method there is great expansion of the lower ribs, and the increase in the capacity of the chest takes place chiefly in this direction. In this form of breathing there is far more control over expiration than when the diaphragm is displaced; the act can be regulated absolutely by the will to suit the requirements of the vocalist. Abdominal inspiration is apt, on the other hand, to be followed by jerky expiration, a defect which is fatal to artistic delivery and most fatiguing to the singer.

The training of the other parts of the vocal machinery, the vibrating element and the resonant apparatus, lies altogether outside my province. What I may call the "fingering" of the vocal cords and the "tuning" of the resonators can be acquired only by constant practice under a good teacher. There is no such thing as a self-taught singer. Constant imitation of the best models and the watchful discipline of an experienced instructor constitute the real secret of the old Italian schools of singing, which gave such splendid results. Tosi insisted that the pupil should never sing at all except in the presence of a master. It is important that the very best teacher that can be found should be chosen; it is a false economy to trust a young voice to an inferior man on the ground of cheapness. To masters I venture to hint that they should strive to train their pupils according to the traditions of the golden age of song before the laryngoscope was invented.

I have only to add that the ear should be not less carefully trained than the vocal organs. An old Scotch minister used to tell his flock that the conscience should be kept "as white as the breest o' a clean sark." The ear is the conscience of the voice, and its purity should be not less jealously guarded. Many singers of the finest vocal endowment fail from a defect of ear; their condition is like that of a color-blind painter. Passing indisposition may sometimes vitiate the ear as well as the temper; the artist should on no account attempt to sing under such circumstances.

Two questions in connection with the training of the voice still remain to be discussed—viz., when it should be commenced, and whether it should be interrupted during the so-called "cracking"

period. With regard to the first of these questions I am strongly of opinion that training can hardly be begun too early. Of course, the kind and amount of practice that are necessary in the adult would be monstrous in a young child, but there is no reason why, even at the age of six or seven, the right method of voice-production should not be taught. Singing, like every other art, is chiefly learned by *imitation*, and it seems a pity to lose the advantage of those precious early years when that faculty is most highly developed. There is no fear of injuring the larynx or straining the voice by elementary instruction of this kind; on the contrary, it is habitual faulty vocalization which is pernicious. The sooner the right way of using the voice is taught the more easy will it be to guard against the contraction of bad habits, which can only be corrected at a later period with infinite trouble. Many of the finest voices have been trained almost from the cradle, so to speak. I need only mention Adelina Patti, Christine Nilsson, Jenny Lind, and Madame Albani; but there are numbers of other queens of song who owe great part of their success to the same cause.

As for the other point, I am still an obstinate dissenter from the "orthodox" teaching of singing-masters on the subject. I have already more than once expressed my belief that there is no reason why training, *within certain limits and under strict supervision by a competent person*, should not be carried on when the voice is in the transition stage of its development from childhood to adolescence. The stock argument, invariably advanced to prove the necessity of suspending the education of the voice till it has passed through the "breaking" period, is that, as the parts are undergoing active changes, they therefore require complete rest. This would equally apply to the limbs, and, in some degree, also to the brain. Yet I am not aware that it has ever been proposed to forbid growing lads from exercising their bodies, even in games involving considerable muscular violence, or to interrupt the education of the mental powers till the brain has become fully formed. Overpressure there may be, no doubt, in voice-training as in other kinds of instruction. All voices are not capable of bearing the same amount of training. Each case must be dealt with according to what doctors call the particular "indications" that may arise. My thesis holds good only as a general rule, to which there may be many individual exceptions. A judicious teacher will, however, have no difficulty in deciding as to the best course to adopt in any given instance.

After the voice has been developed to its utmost capacity, the next thing is to keep it in perfect condition. How is this to be done? As Danton said that the three things needed to insure success were *De l'audace, de l'audace, et encore de l'audace*, I say

the three things necessary to keep the voice in good order are practice, practice, and again practice. A singer who lets his voice lie idle is pretty sure to lose some of his upper notes, his breathing-power falls below its highest standard, and the larynx becomes less supple and less obedient to his will. Another vital point is never, if possible, to use the voice when it is not at its best. The slightest cold deadens to some extent the vibrations of the cords, and the resonators are also thrown out of tune by dryness or excessive moisture of their lining membranes. Bodily weakness or indisposition is reflected in the voice; the cords do not come firmly together, and their tension is insufficient for perfect purity, much less richness, of tone. A most essential element in the care of the voice is attention to the general health. This is very apt to be neglected by singers, who have rather a tendency, as a class, to lead the life of hot-house plants, living in rooms from which fresh air is shut out almost as if it were a pestilence, and taking little or no physical exercise. It is right, no doubt, that a singer should shield his precious instrument from harm as carefully as a violinist protects his Straduarius or Amati, but exaggerated precaution may defeat its object. Even the most dainty of light tenors can not live wrapped up in cotton-wool, and the delicacy engendered by the unhealthy conditions of life which have been referred to makes the slightest exposure to cold or fog almost deadly to his artificially enervated throat. A singer who wishes to keep himself in good voice should rise, if not exactly with his brother minstrel, the lark, at least pretty early, say, before eight in the morning. Tosi says that the best hour for practice is the first of the sun, but this, I fear, is a "counsel of perfection" beyond the virtue of this unheroic age. The singer should take plenty of exercise in the open air, and should harden his constitution by leading, as far as possible, a healthy outdoor life. Nothing gives richness and volume to the voice like vigorous health; an experienced ear can often tell a man's physical condition by the full, generous "ring" of his tones, both in singing and speaking.

There is even more superstition among singers than among speakers, as to what is "good for the voice." A formidable list of things which were supposed by the ancients to be injurious is given by Pliny; it includes such a variety of animal and vegetable substances that one wonders how unfortunate vocalists could have found life worth living under such ultra-Spartan conditions. Our modern *artistes* tend to err rather in the opposite direction, to judge from their extraordinarily comprehensive views as to what is "good" for the voice. Every species of drink, from champagne to hot water, and almost every recognized article of food, including that particularly British institution, cold roast beef, has its devotees. I have no manner of doubt that every one of these

things is really beneficial, not from any occult virtue that there is in them, but because the solids give strength, while the liquids moisten and lubricate the throat. That is the whole secret of the cordials and elixirs in which many vocalists place their trust.

A useful example of the proper care of the voice is to be found in a very unexpected quarter. The Emperor Nero, as is well known, believed himself to be a great artist, a notion of which those about were not likely to disabuse him. His dying words, "*Qualis artifex pereo!*" show that he had at least one feature of the artistic temperament. He sought fame by many paths—in poetry, fiddling, driving, and other branches of the fine arts—to say nothing of his scientific experiments on the bodies of his nearest relations. The imperial *virtuoso* was particularly vain of his voice, which I can well imagine to have been soft and sweet, qualities which often enough accompany a cruel nature. He was proportionately careful of so precious a possession. His system is worth quoting. In addition to such general measures as attending to his liver, and abstaining from such fruits and other food as he fancied to be injurious to his voice, we are told that at night he used to lie on his back with a small plate of lead on his stomach. This was probably for the purpose of checking the tendency to abdominal breathing, which has already been referred to as the less perfect way in respiration for singers. In order to spare his voice all unnecessary fatigue, he gave up haranguing his troops and ceased even to address the Senate. As in later times there were keepers of the king's conscience, Nero gave his voice into the keeping of a *phonascus*. He spoke only in the presence of this vocal director, whose duty it was to warn him when his tones became too loud, or when he seemed to be in danger of straining his voice. To the same functionary was intrusted the formidable duty of checking the emperor's eloquence when it became too impetuous; this he did by covering the imperial orator's mouth with a napkin. It must have needed no small measure of courage to apply this effectual method of "closure" to the arch-tyrant of history when intoxicated with the exuberance of his own vocalization.

While laying stress on the necessity of proper cultivation in order to make the singer capable of giving the greatest pleasure to his hearers with the least amount of fatigue to himself, I venture to add that many singers who are admirably trained have rather a tendency to "o'erstep the modesty of nature" in their delivery. It was said of Flaubert's Salammbô, that it might be Carthaginian, but it was not human; in the same way I am disposed to say of certain highly "artistic" vocal displays which one is sometimes condemned to hear, that it may be song but it assuredly is not music. When listening to such tremendous perform-

ances, I often find myself echoing the words of poor Christopher Sly: "'Tis a very excellent piece of work, madam lady; would 'twere done!" An old Italian writer, himself both a singer and a teacher, most truly says: "*E vaglia 'l vero, dove parla la passione i trilli e i passaggi devon tacere*"—leaving the soul to be moved solely by the beauty of expression. It was this quality of sympathetic expression that made the singing of Tom Moore, who had no "voice" in the technical sense, more moving than that of renowned artists. In an altogether different line, Mr. George Grossmith contrives by the exquisite clearness of his modulation to add considerably to the gayety of nations with a very limited stock of notes.

One of the most remarkable things relating to song at the present day is the scarcity of really fine voices. It will not, I suppose, be seriously argued that the human voice is degenerating, and never were the inducements to cultivate it more abundant or more powerful. Yet, if we are to believe many competent authorities, never were first-rate voices so rare as at the present time. The complaint is not altogether new, and is, in part at least, nothing more than the inevitable moan of the *laudator temporis acti* over the decadence of things in general. Rossini at the zenith of his fame complained that there were so few good voices, and quite at the beginning of the last century we find Tosi speaking of his own period as one of decay. Mancini also (1774) says that vocal art had then fallen very low, a circumstance which he attributes to singers "having forgotten the old systems and the sound practice of the ancient schools." Still, modern writers on singing are agreed that there is a dearth of really beautiful voices at the present time, and, as this is one of the very few points on which these contentious persons are agreed, there can be little doubt of the truth of the fact to which they bear witness. Good tenors are especially rare, even among Italians, the chosen people of song. There are no tenors now who can be compared with Mario or Rubini; indeed, one gathers from Mr. Sims Reeves's reminiscences, published not long ago, that the world is at present blest with only one really first-rate tenor. Mr. Reeves leaves his readers in no doubt as to the identity of this Triton among contemporaneous minnows of song. We have no basso that can stand beside Lablache. Except Madame Patti, whose glorious voice is now too seldom heard, and Madame Christine Nilsson, who, to the regret of all lovers of song, has quitted the lyric stage, Madame Albani and Madame Sembrich are almost the sole inheritors of the renown of the great *prime donne* of old. It is not only in compass and quality that our latter-day voices are inferior to those of preceding generations, but in endurance. Catalani's magnificent voice remained unimpaired up to extreme old age, and Farinelli's

only died with him. Matteucci, when past his eightieth year, used to sing in church every Sunday *per mera devozione*, and such was the freshness and flexibility of his voice that those who could not see him took it to be that of a young man in the flower of his age. Indeed, this was not very uncommon in singers trained according to the best traditions of the old Italian school, which seems to have possessed the secret of perpetual youth as far as the voice was concerned.

Now, to what can our poverty in voices of the highest class be due? I believe to a combination of three different causes: First, inadequacy of training; secondly, the want of good teachers; and, thirdly, the gradual rise of the concert pitch which has taken place in recent years. Insufficient training arises from the breathless haste to "succeed" which is a characteristic of this feverish age. Voices are quickly run up by contract, and as swiftly fall into decay. The preference for supposed "royal roads" over the hard-beaten path that has led former singers to fame is another error which has worked almost as much mischief in song as it has in scholarship. A vocalist nowadays thinks that a year in England and a second year in Italy is all that is needed to equip him for a brilliant artistic career. In "the brave days of old" singers never deemed their vocal education complete until they had given six or seven years to the ceaseless study of their art.

The want of good teachers is closely connected with the inadequacy of modern training, for it is evident that a man who has not himself had the patience or the industry to master his art can not be a satisfactory guide to others. Show and superficial brilliancy of execution are aimed at rather than solidity and thoroughness; more attention is paid to vocal *tours de force* than to artistic ornament. The firm basis of experience has been abandoned for fantastic methods of teaching which are useless when they are not positively harmful. I would earnestly advise all those who profess to impart the divine art of song, like Prospero, to "drown their books," and study the production of the voice as an art, and not as a branch of Chinese metaphysics.

That the high concert pitch now generally used, especially in this country, throws an unnatural strain on even the finest voices, is a fact as to which most authorities are agreed. In the classical period of music, A (second space, treble clef) represented from four hundred and fifteen to four hundred and twenty-nine vibrations; this pitch suited the human voice admirably. The desire to get increasingly brilliant effects from the orchestra forced the pitch higher and higher, till so much confusion prevailed that, in 1859, a French commission fixed the standard pitch at four hundred and thirty-five vibrations. This is called the normal diapason, and is now generally used on the Continent; but England, with her cus-

tomary insular independence, has not conformed to the general rule in the matter, and the pitch has in this country actually risen to four hundred and fifty-eight vibrations. This result is largely due to the extraordinary impulse given to orchestral music by the genius of Costa, who, so long as he could get brilliant effects from his instruments, cared little for the consequences which the rise of pitch entailed on the voice. But it will be said, since it is all a matter of convention, why can not the pitch be lowered? I believe the chief obstacle is the expense which this would involve through the necessity of altering instruments. It has been estimated that it would cost eighty thousand pounds to alter those of the military bands alone, and politicians probably think that these are hardly the times to ask for money for such an object.

But worse even than the undue height of the pitch is the difference between this country and the rest of the civilized world which has just been referred to. Herr Joachim complains that he is obliged to begin screwing up his violin eight weeks before he comes to England, in order that the instrument may not be injured by a sudden change. It is not so easy, however, for the singer to prepare *his* delicately strung instrument in the same way, and the result is necessarily great strain to the vocal cords and throat generally. The high pitch used in England leads to the production of very disagreeable shrieking; notes are delivered which are in no sense artistically beautiful, and which only "split the ears of the groundlings." Nearly all singers are in favor of lowering the pitch. The sole exceptions are, I believe, the contraltos, whom a high pitch does not affect so much as it does others. I know of one justly celebrated contralto who produces an extraordinary effect by her low E. If the pitch were altered this vocal feat would no longer be so wonderful, and it is natural, therefore, that this lady should wish the present state of things to continue.

Perhaps, after all, the supposed scarcity of good voices may be more apparent than real. It is possible that it is not only the pitch but the standard of vocal excellence that has risen. We know how the general level of literary style has risen, and, in particular, how the art of melodious versification has been popularized, if I may use the expression, so that every cheap magazine, and even the poets' corner of provincial newspapers, contains copies of verses which would have earned considerable reputation for the authors a hundred and fifty years ago. It is immensely more difficult now to make a name by writing. May not something of the same kind be the case as regards singing? I fear we must not lay that flattering unction to our souls. Great singers are rarer nowadays than in former times, because voice-training is

almost a lost art. The remedy lies, as has been said, in a return to methods consecrated by glorious tradition, and fruitful of results which, as experience has abundantly proved, can not be attained by shorter or easier ways.—*Contemporary Review.*

[*Concluded.*]

SUSPENSION OF VITALITY IN ANIMALS.

By M. VICTOR LAPORTE.

FAMILIAR instances of suspended vitality, or rather latent vitality, are afforded by seeds, which may be kept for years without showing action, but are yet capable of being recalled to the exercise of the functions of life. Other instances are afforded by the lower organisms, which will remain dry and sterile for indefinite periods, to be brought into full activity at any time by supplying the due degree of moisture and warmth. Coming up to higher forms of life, the same phenomena are usually manifested in insects, one of the normal conditions of whose life—the *nympha* or *chrysalis* state—is characterized by the exhibition of the external appearance of death. During this stage the vital processes are tempered down till only enough are in effect to maintain a merely vegetative existence; yet the insect is capable of slight motions when subjected to a shock or pressure. The duration of this apparent death varies according to the species and to external conditions. There are species that require two years of incubation before going through their metamorphosis. Others pass to the perfect state in a few days. Butterflies demand a certain degree of heat, below which they will not issue. The opening of the chrysalis takes place naturally when these atmospheric conditions are realized. If the season is late, the hatching is also late. Hence we can prolong the duration of the chrysalis state indefinitely by properly adjusting the temperature, delaying to that extent the metamorphosis of the imprisoned mummy into the free and winged insect. Réaumur, by putting chrysalides in an ice-box, was able to keep them alive and retard their development several years.

"Perfect" insects are also capable of passing some time in a more or less definite condition of apparent death without losing the capacity to revive. I do not mean those simulations of death which some species put on in order to escape their enemies, and under which their condition may be mistaken by the most careful and patient observer, but cases in which they revive under really extraordinary conditions. Of such cases are instances of flies, which, having been accidentally inclosed in casks of Madeira

wine shipped to Europe, became lively as soon as they were exposed to the air. Frozen caterpillars are sometimes revived when thawed out. That May-bugs can be restored to life after they have been drowned has been proved by Prof. Balbiani, of the Collége de France, in conclusive experiments. He restored many by drying them in the sun after he had kept them immersed for twenty-four hours, two days, and even five days. In another experiment a stag-beetle, put under alcohol for a half-hour and then dried, was still in motion after three days.

Going higher up in the animal series—eggs, which are analogous to the seeds of plants, present a remarkable example of retarded life. One of the most interesting features about them is the independence of their vitality, which persists even when the individual that has produced them, and within whose organism they are still contained, has ceased to live. This fact has been recognized in pisciculture, where artificial fecundation has been successful with eggs taken from dead fish.

The persistence of life in frogs is very long. Spallanzani preserved some frogs in a mass of snow for two years. They became dry, stiff, and almost friable, but a gradual heat brought them back to life. Vulpian observed a return of life in frogs and salamanders that had been poisoned with curare and nicotine. In both cases the animals in question had been for several days in the condition of cadavers. Toads have been shut up in blocks of plaster, and then, having been deprived of all air except what may penetrate through the material, and of all sources of food, resuscitated several years afterward. This question presents one of the most curious problems that biological science has been called on to explain. The longevity and vital resistance of toads are surprising. Besides the experiments we have cited, Nature sometimes presents some already made, and vastly more astonishing. Toads are said to have been found in rocks. Such cases are rare, but it would be as unreasonable to doubt them as to believe in some of the miraculous explanations that have been made of the matter. The phenomenon is marvelous, it is true, but it is supported by evidence that we are not able to contest; and skepticism, which is incompatible with science, will have to disappear if rigorous observation shall confirm it. The toad was observed, in one case, in the stone itself, and before, recovering from its long lethargy, it had made any motion. One of these toads was presented to an academy, with the stone which had served it as a coffin or habitation, and it was ascertained that the cavity seemed to correspond exactly with the dimensions and form of the animal. It is remarkable that these toad-stones are very hard and not at all porous, and show no signs of fissure. The mind, completely baffled in the presence of the fact, is equally

embarrassed to explain how the toad could live in its singular prison and how it became shut up there. The strangest ideas have been expressed on this point. The ridiculous hypothesis has even been proposed of an imperceptible toad-germ that was developed in the interior of the stone. The fact of the survival of the toad, despite the impenetrability of the stone, becomes less doubtful when we recollect the similar experiments on animals inclosed in plaster, which we have mentioned above. But the problem of the toad's introduction into the stone still remains unsolved.

M. Charles Richet had occasion to study this question some months ago, and came to the conclusion that the fact was real, observing that even if, in the actual condition of science, certain phenomena were still inexplicable, we were not warranted in denying their existence, for new discoveries might at any time furnish an explanation of them. "The true may sometimes not be probable." But science takes accounting of the truth, not of the probability.

Hibernating mammalia are capable of putting on all the appearance of death. The marmot, during its lethargic sleep, is cold, the temperature of its body being hardly 1° C. above that without. It respires only three times a minute; and the beatings of the heart, which rise to ninety a minute in the active life of the animal, fall to ten in a minute. Bats, during the cold season, hang like dead bodies. One may take them in his hands, press them, and throw them into the air, without their manifesting any sign of feeling.—*Translated for the Popular Science Monthly from La Monde de la Science et de l'Industrie.*

SKETCH OF ROBERT KOCH.

ONE of the most eminent of the colaborers of Pasteur in the investigation of the relations of micro-organisms to disease-infection, and one whose labors have been most fully appreciated by intelligent men, is Dr. ROBERT KOCH, of Berlin. He was born at Clausthal on the 11th of December, 1843, the son of a high officer in the department of mines. He attended the gymnasium in his native town, and afterward—from 1862 to 1866—studied medicine at Göttingen. He became an assistant in the Allgemeine Krankenhaus, or General Hospital, at Hamburg; began the practice of medicine in 1866 at Langenhagen in Hanover; then settled at Racknitz, in Posen. From 1872 till 1880 he was *physikus* or district physician at Wallstein, in the district of Bomst. He engaged in studies of bacteriological diseases, including wound-

infections, septicæmia, and anthrax, or splenic fever, with great success; and was appointed in 1880 a member in ordinary of the Imperial Health Office. In 1885 he was appointed a professor, and the director of the Hygienic Institute in Berlin.

The first public report of Dr. Koch's to attract general attention was that in reference to the bacterium which had been found associated with anthrax, or splenic disease, and was made about 1878. His investigations went to show that the potency of this organism lay in the spores rather than in the developed bacterium. He found that, when no spores were visible in the dried diseased blood with which mice were inoculated, the power of conveying infection lasted only for a few weeks; while blood in which the spores had separated continued virulent for at least four years.

He next turned his attention to those infectious disorders which originate in the introduction of poisonous matter through wounds. Living organisms had already been observed in these diseases, but their connection with the development of the infection had not been determined. Dr. Koch's experiments with small animals showed that different forms of disease were produced by the injection of putrid blood, one of which was not accompanied by the development of bacteria, but seemed due to a special poison which he named *septin* or *sepsin*, while another form was evidently bacterial; and that the effects varied with different animals.

In 1882 Dr. Koch published the results of experiments which went to confirm the opinion already held by physicians who had observed the progress of the discovery of the fungoid origin of various infections, that tubercular disease was also caused by microphytic germs. He claimed not only that he had ascertained the bacterial origin of the disease, but to have detected the specific microbe, having found a characteristic and previously unknown bacillus in all tubercularly altered organs. He had observed it in pulmonary tuberculosis, cheesy bronchitis and pneumonia, tubercles of the brain, intestinal tubercles, scrofulous glands, and fungous inflammation of the joints; in all cases which he had examined of spontaneous consumption in animals—in cattle, hogs, poultry, monkeys, porpoises, and rabbits. In monkeys dead of consumption he had found the organisms in quanities pervading the lungs, spleen, liver, diaphragm, and lymphatic glands. He supposed that, escaping into the air from the expectorations of phthisical patients, they were inhaled into the lungs, where they developed. Whenever the tubercular process was in its early and active stage, they were present in great numbers. When the climax of the tubercular eruption was passed, they decreased and might totally disappear.

Dr. Koch's report of this investigation was published in one of

the Berlin medical journals, in a memoir on "The Etiology of Tuberculosis," of which Dr. Klein, a distinguished pathologist, said that any one who carefully reviewed it would "come to the conclusion that Dr. Koch's results are to be accepted with unconditional faith, and I have no manner of doubt will be considered by all pathologists as of the very highest importance. To those who are familiar with Dr. Koch's previous work, especially that on the etiology of splenic fever, or anthrax, and his observations on pathogenic bacteria, this last work of his, on the etiology of tuberculosis, will be an additional and brilliant testimony to his ingenious and successful method of research." This testimony is the more significant because Dr. Klein afterward disputed Koch's identification of the "comma bacillus" with the cause of cholera. In the next year a report was published by Mr. Watson Cheyne of a visit which he had made as a commissioner of the British Association for the Advancement of Medicine by Research, to the laboratory of Dr. Koch, and also to that of M. Toussaint, who was engaged in a similar investigation. It represented that such results of Toussaint as disagreed with those obtained by Dr. Koch were not borne out. But the result of inoculation with cultivations obtained from Dr. Koch was in all cases rapid development of tuberculosis. The examination of a large quantity of tuberculous material showed the constant presence of tubercle bacilli, but of no other micro-organisms. The rapidity and certainty of action of this matter, when inoculated into animals, was in direct ratio to the number of bacilli introduced, and the most certain and rapid means of inducing tuberculosis seemed to be the inoculation of the tubercle bacillus cultivated on solid blood-serum. These facts led Mr. Cheyne to the conclusion that these bacilli are the virus of the acute tuberculosis caused in animals by inoculation.

When the cholera broke out in Egypt in 1883, the German Government appointed Dr. Koch chief of a commission to go to that country, and also to India, for the purpose of watching the course of the epidemic and investigating the nature and cause of the disease. The report of the work of this commission in Egypt, published in the early autumn of 1883, while it did not make known any certain results of the investigation, and dealt "in a very guarded manner" with the question of the discovery of a definite cholera bacillus, pointed out the line on which future studies were to be pursued. In experiments carried on in both living and dead subjects, while no distinct organism could be traced in the blood and the organs which are most frequently the seat of micro-parasites, bacteria having distinct characteristics were found in the intestines and their mucous linings, under circumstances that seemed to identify them with the disease from

which the patients were suffering. They were present in the case of all patients suffering from cholera, and in the bodies of all who had died of it, whereas they were absent in the case of one patient who had had time to recover from cholera, but had died of some secondary complication; and they were not discoverable in the case of patients who, during the cholera epidemic, succumbed to other diseases. They were also the same with the bacillus which Dr. Koch had met the year before in the bodies of patients who had died of cholera in India. From these causes the commission felt justified in provisionally holding the belief that those bacilli were in some way related to cholera, but were not yet prepared to say whether they were the cause or the effect of the disease. In 1884 Dr. Koch visited Toulon, where cholera was raging, partly at the wish of the French Government, which desired to know more of his methods of investigating and suppressing the disease.

The investigations of the German commission were continued in India, and Dr. Koch's report on the subject was published in the "Klinische Wochenschrift," of Berlin, No. xxxiv, 1884. He had found, in the rice-water discharges of patients suffering from cholera, besides the micrococci and bacilli common to the evacuations of other patients, peculiar curved bacteria, which have become known as "comma-shaped" bacilli, such as he had not been able to discover in any cases of diarrhœa; and he had succeeded in isolating them by artificial culture. This he declared to be a specific micro-organism having marked characteristics distinguishing it from all other known organisms. These organisms grow rapidly in meat-infusion and blood-serum, and well in other fluids, especially milk, and in potatoes; and possess the power of active motion. They grow best at a temperature of between 30° and 40° C., and cease to grow at 16° C., but are not killed by freezing. They grow only in the presence of oxygen, and very fast; their vegetation rapidly reaches its highest point, then remains stationary for a time, after which it ceases as rapidly as it grew, and the bacilli die. When dried, they die within three hours; and they do not form spores. Micro-organisms possessing all of these and certain more delicate characteristics which are definitely described, are Koch's bacilli; organisms presenting only some of the characteristics, such as microscopical appearance, are something else.

The presence of these bacilli in cholera, which was represented as universal, was determined by microscopical examination in ten cases in Egypt, and by microscopical examination and cultivation in gelatinous meat-infusion in forty-two cases of *post-mortem* examination in India; and in numerous other cases of dejections in Egypt, India, and Toulon—giving a hundred cases occurring in various parts of the world, carefully examined, in which the

organisms were found. It had been further found that this was the only form of micro-organism that was constantly present in the disease; that it was present in greatest numbers in acute and uncomplicated cases, and in the parts most affected; while it was never present in other diseases, in healthy persons, and had not been found outside of the body where no cholera was in the neighborhood. Then, having disposed of two hypothetical presumptions of contrary tenor, Dr. Koch declared that no other conclusion could be arrived at than that these bacilli are the cause of cholera.

Although no effects had then been obtained from experiments with comma bacillus upon animals, and direct experiments upon man could not be performed, various observations confirming the theory had been obtained which were almost as good as experiments on man. In the water of a tank whence the inhabitants of a village near Calcutta derived their supplies for drinking, cholera bacilli were found in considerable numbers when the cholera epidemic was at its height. At a later period, when there were only a few cases of illness, the comma bacilli were few in number, and found only at one part of the tank. This was the only instance in which these bacilli were found outside of the body. Finally, Dr. Koch maintained that the natural history of the disease corresponds with the various characteristics of the organism in question. The bacilli grow rapidly, soon reach their highest point of development, then die, in correspondence with what occurs in the intestinal canal. Under ordinary circumstances the bacilli are destroyed in the healthy stomach, while persons suffering already from some disorder of the stomach are most liable to be attacked with cholera. Lastly, the disease dies out in places where the conditions for its continuance are unfavorable; as bacilli that have no spores will speedily disappear. In experiments subsequent to this report, Dr. Koch succeeded in producing cholera by inoculation in some of the smaller animals.

Dr. Koch's conclusions were contested and some of his evidences were disputed by a French commission appointed to inquire into the causes of cholera; by certain English pathologists, including Dr. Klein and Dr. Lewis, of Netley; and were not fully supported by an English commission in India; but, while they may not yet have been fully accepted, they have not been overthrown, nor do they seem to have lost ground. A bill was unanimously passed by the German Parliament, in 1884, awarding a sum of 135,000 marks to Dr. Koch and his companions in this research.

The principal published works of Dr. Koch are "Etiology of Splenic Fever," 1876; "Researches on Diseases of Wound-Infections," 1878; "Inoculation for Splenic Fever," 1882; "Contributions to the Etiology of Tuberculosis," 1882; and contributions to the transactions of the German Imperial Health Bureau.

EDITOR'S TABLE.

EVERY-DAY SCIENCE.

IF, on the one hand, we have frequent cause for astonishment at the rapidity with which modern life is being transformed under the influence of scientific invention and discovery, we are, on the other, sometimes compelled to wonder at the extreme slowness with which certain useful and entirely practicable reforms, plainly indicated by acknowledged scientific principles, are adopted by the public. There is a law in these matters which has perhaps never been very clearly formulated, but which it would certainly be desirable to understand. The telephone makes its way everywhere without pause or check, and the same is true of electric lighting and traction; while scientific cookery, though its general principles may be said to be fully established, lags painfully behind. That the latter is a matter of the utmost importance, economically and hygienically considered, needs no laborious demonstration; yet how to interest the public in it seems to be a most difficult problem. People who go wild over the New Jerusalem of "Looking Backward" listen with cold indifference when it is explained to them how they can introduce here and now a most important amelioration in their own lives by economizing at once their worldly substance and the wear and tear of their physical organs. The fact that the reform in question would be particularly beneficial to the so-called "working classes" fails to commend it to those who want a revolution or nothing. It is probably the case that men in general are more interested in spending than in saving, just as they have more admiration to bestow on a great warrior than on a great philanthropist; and that, consequently, inventions that represent and call for expenditure are more attractive than those which simply promote economy. More than one modern "improvement," we doubt not, has been adopted by many, as much from the pleasure of spending and—perhaps a more potent consideration still—of appearing to be able to spend the money required to procure it, as from a sense of its utility.

However this may be, and whatever the law may be which regulates public interest in the practical applications of science, there can be no doubt that reform in culinary operations is deserving of far more attention than it has hitherto received. As we showed last month, it deals with a prime—may we not say *the* prime?—necessity of human life. It undertakes to substitute for a wasteful and hurtful empiricism in diet a scientific, economical, and wholesome method of preparing food for consumption. It shows us how we may save our pockets, how we may save our tissues, how we may lengthen our lives, and how we may increase our enjoyments. It promises to improve our tempers by decreasing the internal friction of our physical systems; and, of course, decrease of internal friction means increase in our efficiency for all good purposes. Unlike some reforms that exist only on paper, and that attract sentimental people for the very reason that they are never likely to have more than a paper basis, this particular reform has been tried and realized. Its results are known and can be exhibited at any moment. What is now required is that people should be persuaded that the thing is worth doing, and should be roused to shake off that lazy love of established routine which alone stands in the way of their doing it. The ordinary cooking-stove has so long been a kind of domestic Joss that its worship is hard

to overthrow. That it is not a purely beneficent divinity many a sweltering attendant and many a dyspeptic partaker at the altar are prepared to attest; but pure beneficence, as every one knows, is not a quality that votaries always exact of their deities. Thus, just as long ago, at Ephesus, there were shrine-makers who stoutly withstood the new-fangled ideas broached by Paul, so to-day there are shrine-makers — i. e., stove-makers — who can not be expected to take very kindly to the ideas of our modern apostles of scientific cookery. We can not blame them if they are not in a hurry to break their molds and send their castings to the junk-shop; but, all the same, a reform so deeply founded in common sense must come in time, and it would be well to prepare for its coming by gradually approximating to the type of cooking apparatus required.

It is not in the matter of cookery alone that science is prepared to lend a helping hand in every-day life. There are a hundred reforms remaining to be accomplished, each one of which would do something to make our lives more worthy of rational beings. The most important and beneficent ones are those that can only be wrought by the earnest co-operation of each individual. What we have to do is to see that a duty lies in making the most of our knowledge; and it can nowhere be caused to yield a larger return than in its application to those ordinary affairs of life with which all are concerned.

A COMPARISON IN RACIAL DEVELOPMENTS.

Colonel Garrick Mallery's address on "Israelite and Indian," which is concluded in this number of the "Monthly," presents an unusually lucid and interesting study in comparative civilization and religion. The author's purpose in selecting these two particular peoples for comparison is, as he declares in the beginning, not because there is any special resemblance between them more than between any two other peoples at corresponding stages of civilization, but because they offer convenient types illustrative of a general principle. We are familiar with both—with the Israelites, through the universal habitual study of the Bible; and with the Indians, by virtue of our historical intercourse with them; and the illustrative incidents do not have to be explained, as they would be in the case of any other two peoples that might have been selected. The principle, which has been reached by anthropologists and students of religion generally, and is admitted by many eminent theologians—that religion is a thing of growth, and subject to continual development and refinement, and keeping pace with the advance of each nation in civilization and knowledge—is well set forth in the examples cited. The article bears the marks throughout that the author has studied the subject carefully and to the bottom. On the Israelite side he displays a critical knowledge of the Bible and the environment within which it was composed; besides which, he has brought to bear upon his argument the results of the investigations of that band of eminent scholars whose conclusions, under the name of the "higher criticism," have deeply moved the theological world. On the Indian side, he is at home in his own special field of research. Taking the two peoples at those periods in their history when they had reached nearly equivalent stages in civilization, he holds up the parallelisms in their religious opinions, particularly their ideas of God and a future state, their myths and their social usages, which, he assumes, were not peculiar to them, but could be found also among other bodies of people in the same stages of culture. That similar parallelisms are to be found among other nations of like civilization is a fact familiar to students of Oriental archæology.

The weight of interest will center upon Colonel Mallery's demonstration that the Israelites, at the period under examination, were polytheists. The interest is heightened by the appearance, in the "Jewish Quarterly Review" (London) for October, 1889, of a learned and exhaustive article by the Rev. Prof. A. H. Sayce, under the title "Polytheism in Primitive Israel," which comes to the same conclusion. Most of the points mentioned by Colonel Mallery in this regard are also brought out by Prof. Sayce, of course independently and with much greater elaboration. Some of his more striking passages may be quoted. He speaks of "the Israelites who first ventured to use the plural Elohim of their national God," and adds: "The fact that the Israelites never forgot that it [Elohim] was a plural term, that up to the last they often employed it in a plural sense, proves that the earliest users of it were worshipers of many deities. . . . We may gather from the history of Micah, in Judges xviii, that the worship of the teraphim was the necessary accompaniment of the tribal worship of Yahveh, as represented by a 'carved image,' and in the case of the tribe of Dan, at all events, it lasted 'until the day of the captivity.' . . . Yahveh was not yet conceived of as the sole god. . . . It was in Judah that the older cult first died out of the popular belief. After the division of the kingdom, Judah with its central capital at Jerusalem formed a compact and organized community, in which the earlier tribal distinctions which had marked it off from Simeon, or Dan and Benjamin, were soon obliterated. The dynasty of David welded the community together, and the Temple of Solomon became more and more the center of the common faith. The worship that was carried on in it, the belief of which it was the outward expression, the religious teaching and influence which emanated from it, gradually affected the ideas and convictions of the Jewish people. A time came at length when Josiah could venture to destroy the 'high places' where the old local cults had been carried on for unnumbered generations, and order his subjects to 'worship before the altar' at Jerusalem alone." Prof. Sayce also denies that the Semites were fundamentally monotheistic.

This publication by one of the most learned of living Oriental scholars, who is a professor in the University of Oxford and a clergyman of the Church of England, is important as corroborating the statements of fact from which Colonel Mallery has drawn anthropologic lessons.

LITERARY NOTICES.

SCIENTIFIC PAPERS OF ASA GRAY. Selected by CHARLES SPRAGUE SARGENT. Boston and New York: Houghton, Mifflin & Co. 2 vols. Pp. 397 and 503. Price, $3 each.

THE literary value of the papers contained in these volumes is equal to their scientific value, and that is well understood. Botanical criticism and description are not usually classed among literary subjects, but Prof. Gray made them one; and a large proportion of what he has written in that field is æsthetically enjoyable. The period of his scientific writing lasted fifty-three years—from 1834 to 1887—and during that time he made a remarkable number and variety of contributions, all stamped with evidence of thoroughness and the complete familiarity with his subject that seem to have been habitual with him. His writings are grouped by Mr. Sargent in four divisions. The first in importance contains his contributions to descriptive botany, relating chiefly to the flora of North America; "and although," says the editor, "it did not fall to his lot . . . to elaborate any one of the great families of plants, the extent and character of his contributions to systematic botany will place his name among those of the masters of the science." Next in importance are his educational works, manuals or text-books, the influence of which on the development of botanical knowledge in this country has been great. The third

group includes a series of critical reviews of important scientific publications, and of historical accounts of the lives and labors of workers in botany; and the fourth group a number of papers which owe their existence to the discussions that followed the publication of Darwin's "Origin of Species." The present volumes contain a selection of papers from the third group, with a few essays on subjects of general interest to botanists. Most of these papers, unlike those of the other groups, which are still in the market, have long been out of print, and have not been incorporated in any recent publication. The selections have been made with the thought of presenting, as far as might be, a view of the growth of botanical science during the fifty years through which the papers run—a period which, as the editor observes, is marked by the gradual change of ideas among naturalists upon the origin and fixity of species that has broadened the field of all biological investigation. The period was also characterized by a great increase and diffusion of the knowledge of botany in the United States, and by the growth of a body of earnest, energetic American botanists, who have not only given vigor to the study and inspired interest in it through all the schools, but have also contributed to exalt the reputation of American science; and these botanists are, and are what they are, almost wholly by reason of what Prof. Gray and his books taught them.

A glimpse of the condition of botanical study in the United States at the beginning of Prof. Gray's fifty years is afforded in the first of the papers, which is a review of the second edition of Lindley's "Natural System of Botany," published in 1836–'37. The intimation that "we do not intend to engage in a defense of what is called the natural system of botany" indicates that that system had not yet fully conquered acceptance. Still, the author assumed that the science could by no other method be successfully and philosophically pursued, and added: "The few persons who remain at this day unconvinced of its advantages are not likely to be affected by any arguments that we could adduce. A somewhat larger number may perhaps be found in this country who admit the importance and utility of the natural arrangement in the abstract, but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles." But the system had grown in favor during the preceding six years. Twenty years later, in the review of Henfrey's "Botany," 1857, we are given this picture of the condition of botanical instruction here: "While in England botany is scarcely an academical study, here it pertains to collegiate and academical instruction where it is taught at all. In Europe not even an apothecary can be licensed without passing an examination in botany; in the United States, we believe, it forms no part, at least no regular part, of the medical curriculum; no medical school has a botanical chair; and no knowledge whatever of the science of the vegetable kingdom, which supplies the *materia medica*, is required for the degree of Doctor in Medicine!" With botanical chairs in a large number of our leading universities and schools, filled by experts who are engaged in original work and encourage it in their students; and pupils in high schools knowing more of the structure and qualities of plants than the doctors Prof. Gray describes, we of the present time have no reason to be ashamed of the advance that has been made. From these almost elementary considerations, the reviews and essays follow the series of publications in the science and the course of discussion over the whole scientific world, while having an eye primarily to America, including such subjects as Van Mohl's observations of the cell; De Candolle's theories of variation and distribution and of the origin of cultivated plants, in reviewing which the author displays the sharpness of his discernment and the thoroughness of his knowledge regarding American plants; Radlkofer's and Henslow's studies in fertilization; the principles of nomenclature and the definition of species; several local floras and special studies, never forgetting those that are primarily of American interest; and those studies in which Prof. Gray so greatly supported and aided Darwin, relative to variation and the origin of species. In these notices, while some of them seem to bristle with technicalities and run to details, the techni-

calities and details are never all, and are seldom a prominent feature. A lesson of general application is to be drawn in each of them, and is drawn and presented with such directness and lucidity that even young students can comprehend it and be interested in it. The essays in the second volume are more extended discussions of special topics, among which are "The Longevity of Trees," "The Sequoia and its History," "Do Varieties wear out, or tend to wear out?" "Forest Geology and Archæology," "The Pertinacity and Predominance of Weeds," and two on the flora of North America. Many of these papers, as well as no small number of the "Reviews," had not Prof. Gray been so preeminently a man of science, might have established his reputation as a literary essayist of the first rank. In some of them the author co-operates with Heer and De Saporta, anticipating the chief publications of the latter author, in working out the theory of the arctic origin of the plants of the temperate zone. "Notes on a Botanical Excursion to the Mountains of North Carolina" is a letter to Hooker, recording the experiences and observations acquired in a visit to a region which was of peculiar interest at the time, and is equally so now, on account of the number and variety of rare plants to be found there. This excursion seems to have been an exception to the general course of Prof. Gray's life; for, in an address at the American Association meeting in 1872, on "The Sequoia and its History," when he had just visited a unique botanical region in California, he says that, so far as our country was concerned, he had been to a great extent a closet botanist, and had not before seen the Mississippi or set foot upon a prairie. Through all of these papers Prof. Gray's style is clear; he goes directly for the point; is judicially minded; always at home, searching in criticism; and sometimes, as when dealing with Mr. Ruskin or exposing an error of the authors on whom Henfrey relies, keen in sarcasm. And the editor's observation that "his reviews represented the opinion of a just and discriminating mind, thoroughly familiar with all sides of the question before it, critical rather than laudatory, loving the truth and its investigators, but the truth above everything else," is fully borne out.

SIXTH ANNUAL REPORT OF THE BUREAU OF ETHNOLOGY, 1884–'85. By J. W. POWELL, Director. Washington: Government Printing-Office. Pp. lviii + 675.

IT is impossible to examine one of these handsome volumes without being deeply impressed by the extent of the work that is being done and the interest of the store of information that is being secured by this bureau. The report of the director states that the field-work of the year comprised mound explorations by several assistants under the charge of Prof. Cyrus Thomas; researches in the ancient ruins of the Southwest by parties in charge of Mr. James Stevenson and Mr. Victor Mindeleff; linguistic field-work by Mrs. Erminnie A. Smith, Mr. H. W. Henshaw, Mr. A. S. Gatschet, Rev. J. Owen Dorsey, and Mr. Jeremiah Curtin. General ethnological investigations in the field were carried on by Dr. Washington Matthews, Dr. H. C. Yarrow, and Dr. W. J. Hoffman. Office-work on sign-language and pictographs was continued by Colonel Garrick Mallery; on bibliography of North American languages, by Mr. James C. Pilling; on the myths and customs of the Zuñi, by Mr. Frank H. Cushing; on ceramics, by Mr. W. H. Holmes; on a historical atlas of Indian concessions, by Mr. Charles C. Royce; and by the explorers above mentioned, on their several specialties, when not engaged in field-work. The first of the papers accompanying the report is on "Ancient Art of the Province of Chiriqui, Colombia," by William H. Holmes, and is based on the large collection of archæologic material from the province in the National Museum. The paper contains a wealth of information in regard to the works of the ancient inhabitants of this interesting region, and its descriptions are assisted by 286 illustrations. A curious feature of the Chiriquian objects buried with the dead is that they appear to have been made for that purpose, and not for use by the living. Another paper by Mr. Holmes is "A Study of the Textile Art in its Relation to the Development of Form and Ornament." Mr. Holmes gives an instructive analysis of the forces and influences inherent in the textile art, the first lessons of which are order, uniformity, and symmetry. He discusses the influence of textile ornament upon other forms of art, such as architect-

ure and sculpture, and also the manner in which intrinsic decorative elements are remodeled in accordance with the rules of textile combination. The paper is illustrated with 73 figures. Prof. Cyrus Thomas supplements his former publications on American palæographic literature with "Aids to the Study of the Maya Codices," embodying some original discoveries, and some explanations not already brought forward. Plates 50 to 58 of the Dresden Codex, and portions of other plates of the Dresden and other codices, are figured in the text. Rev. J. Owen Dorsey furnishes an account of a secret society of seven degrees, still existing among the Osage, in which the traditions of the people have been preserved. This is accompanied by two of these traditions in the original language, which he has succeeded in obtaining, together with an interlinear and a free translation of each, with explanatory remarks. An extended account of "The Central Eskimo" is contributed by Dr. Franz Boas, who spent a considerable time among these people in the region between Hudson and Baffin Bays. The scope of the paper includes the topography of the region, the distribution, tribal divisions, and numbers of the inhabitants, their habits and customs, their religious practices and beliefs, with translations of their myths and legends, and descriptions of their peculiar and ingenious weapons, implements, and utensils. Much work of previous explorers has also been incorporated with the original material in this account. The paper is illustrated with 156 figures and nine plates, two of the latter being folded maps and six representing Eskimo drawings or carvings. A feature of the paper is the notation of a number of Eskimo songs.

CATALOGUE OF CANADIAN PLANTS. Parts I to IV. By JOHN MACOUN, M. A., F. L. S., F. R. S. C., Naturalist to the Geological and Natural History Survey of Canada.

RECENT years have brought to the botany of North America few contributions more valuable than the "Catalogue of Canadian Plants," by Prof. Macoun. The entire work has been issued within the past six years, the first part appearing in 1883, the fourth in 1888, and only recently distributed; but these six years bear only small proportion to the actual amount of time the work has cost. Prof. Macoun gives us the labor of a life. For nearly forty years he has been an indefatigable explorer and systematist, pursuing his investigations from Newfoundland to Vancouver's, from the Lakes to the Arctic Circle. The plan of the work contemplates an exact enumeration of the vegetable life of the Dominion, but virtually the plants of all northern North America are included, Alaska and even Greenland not being forgotten. For this area not only is each species named, but for each, to the extent of present knowledge, is given its geographical range as well, its distribution, also its synonymy, and, in many cases, notes concerning habit and habitat. Facts of distribution are given with unusual exactness. For every plant each station is named and the name of the collector given, so that the catalogue is no mere check-list, but in so far an authentic geographical botany.

It were a pleasing task, did the limits of this review permit, to notice at length many of the interesting points which this catalogue brings to light. Each specialist will, of course, scan the field in search of his own particular favorites, but every one at all familiar with North American botany will enjoy tracing the distribution of some of our more common or interesting forms. The common quaking asp (*Populus tremuloides*), for example, occupies the whole Northwest, from Labrador to Alaska. The sundew (*Drosera rotundifolia*), common in New England, but a plant which many a Western botanist has vainly desired to see, is reported common from Newfoundland west to the Pacific, and north to the Arctic Sea. *Dodecatheon Meadia* likewise runs north and west, and shoots its dainty stars in far Alaska, while plumes of *Hordeum jubatum* wave on the banks of the Mackenzie and Yukon. Few trees cross the continent from east to west. The paper birch (*Betula papyrifera*) is one. With this may be named *Picea alba* and *Picea nigra*. These two spruces start together in Newfoundland and extend westward across the continent side by side, until the former is replaced in Columbia by *P. Engelmanii*, with which in the Athabascan region it seems to blend, while the latter (*P. nigra*) drifts northward, until it finally vanishes side by side with the paper birch hard by the waters of

the northern sea. All the species that pass from east to west seem to be northern forms. *Lonicera involucrata*, however, crosses the continent from New Brunswick to the sea-level of the Pacific coast. Very few plants whose center of distribution is west of the Rocky Mountains appear in the flora of the East. *Pseudotsuga Douglasii* comes as far east as longitude 114°; *Pinus Murrayana*, longitude 110°; *Rubus nutkanus* reaches Sault Ste. Marie, and *Goodyera Menziesii* the shores of Lake Ontario.

Some species which in those northern regions bind the floras east and west will interest naturalists generally by reason of peculiarly isolated distribution. Thus, *Armeria vulgaris*, common on sea-shores around the entire North, is found in profusion on the summit of Mount Albert, Gaspé. *Vaccinium ovalifolium*, reported in the United States from a single locality on the south shore of Lake Superior, occurs at many stations in the far Northwest and also on the summit of Mount Albert. *Galium kamtschaticum*, another arctic species, occupies the same interesting locality. *Heliotropium curassavicum*, characteristic rather of our Southern flora, surprises us by appearing abundantly away north and west of the Saskatchewan.

Six parts will show this excellent catalogue complete. Of these, the four already published are devoted to phenogamous plants exclusively; Part V will present the ferns and mosses; while algæ and fungi are relegated to Part VI.

HANDBOOK OF PSYCHOLOGY; SENSES AND INTELLECT. By JAMES MARK BALDWIN, Ph. D., Professor in Lake Forest University. New York: Henry Holt & Co. 1889. 8vo. Pp. 343. Price, $2.25.

IN this book the author displays a thorough acquaintance with the works of those writers on the subject whose general philosophical attitude is different from his own, and he often adopts their conclusions, freely recognizing their merits. The references show a wide acquaintance with psychological works in all languages, and are impartially made, with no discrimination in favor of either Trojan or Tyrian, the author evidently intending that the reader shall be made fully acquainted with the literature of the various topics treated. The work is that of a scholar, the style is good, and many special themes are well handled. This is particularly true of sensation, though the selection of the word *tone* to characterize the quality of sensation as pleasurable or painful does not seem to us felicitous. So also the chapter on illusions is an excellent presentation in condensed form of a class of very interesting mental phenomena.

But while the author makes good use of the results of scientific psychological study, his work is vitiated by an inability to get rid of the notion that Psychology must be made a servant of Theology. We are reminded by his book of Dr. McCosh's works, though Dr. Baldwin is much less anachronistic. The difficulty is the old heresy that the human mind has a special and higher faculty for seeing things invisible, by a rational or intuitional apprehension. The moment we apply the term *intuition* alike to presentative knowledge and to representative products—concepts, judgments, inferences—as does Dr. Baldwin, we destroy the fundamental psychological distinction, and make a jumble of mental science. This is what is always done by those who insist on a "reason" and on "rational intuitions."

We have yet to see any fairer or better handbooks of psychology than Prof. Bain's and Mr. James Sully's, and either of these we should certainly recommend in preference to the present work, which, spite of excellences, is essentially misleading by reason of errors mostly growing out of the above-mentioned confusion.

"THE NEW REVIEW." Edited by ARCHIBALD GOVE. Monthly. London and New York: Longmans, Green & Co. Price, 15 cents a number, $1.75 a year.

THIS addition to the number of monthly reviews deserves to be classed with the best. The first number was that for June, 1889, and the issues that have already appeared have been filled with the contributions of able and well-known writers. Being an English magazine, of course it contains some articles that the American reader would skip as being of rather remote interest; but much of its contents knows no nationality, for instance, "After the Play," by Henry James, and "The Dying Drama," a reply by William

Archer; also "The Religion of Self-Respect," by Mrs. Lynn Linton; "A Month in Russia," by Lady Randolph Churchill; "Wrestling in Japan," by the Hon. George N. Curzon, M. P. Papers on General Boulanger, the French elections, and the German emperor are among the contents of the early numbers, and the scientific arts are represented by an article on "The Eiffel Tower," by M. Eiffel, and one on "Electric Lighting," by the Duke of Marlborough. English political problems, general sociological questions, literature, history, and biography are among the fields which "The New Review" has already entered, and Charles Bradlaugh, St. George Mivart, M. Flourens, and Andrew Lang are among the contributors not already mentioned. Its mechanical work is excellent.

HANDY LISTS OF TECHNICAL LITERATURE. Part I. USEFUL ARTS IN GENERAL, PRODUCTS AND PROCESSES USED IN MANUFACTURE, TECHNOLOGY, AND TRADES. Compiled by H. E. HAFERKORN and PAUL HEISE. Milwaukee: National Publishing and Printing Company. Pp. 99. Price with Key, $1.25 paper; $1.50 cloth.

As one of the tools of the book trade, this series of lists can not fail to be of value. It furnishes information about a class of books, many of which are published and distributed through other than the well-known trade channels, and hence are not easily found. Part I, already issued, contains titles of books in English published since 1880 of the classes specified in its title, entered alphabetically under the author's name, or, if anonymous, under the first word of the title. Each title is numbered, and the names of subjects are inserted in the same list, with cross-references to the titles. References are given also to articles in cyclopædias and to parts of works treating of the various subjects. The size, price, and date of each book are given, and the publisher is indicated by an abbreviation. The key consists of a list of the publishers' names for which these abbreviations stand, with addresses, each followed by the list-numbers of the books mentioned which the publisher issues or keeps on sale. An appendix to the "Handy List" consists of a selection of books of the same class published before 1880, and still kept on publishers' and jobbers' lists. Other parts to be published will include lists on military and marine affairs, engineering, mining, fine arts, building, and miscellaneous subjects.

A DICTIONARY OF MUSIC AND MUSICIANS. Edited by GEORGE GROVE. Appendix. London and New York: Macmillan & Co. Pp. 306. Price, $2.25.

THE large demand for this elaborate work, which now appears in a complete form, with its steady increase from the beginning, in Europe and America, are accepted by the publishers as showing that on the whole the book has fulfilled the intentions with which it started. Shortcomings were to be expected, and may be found; but with all the allowance that need be made for them, the value of the work is exceedingly great, and is far more than an equivalent return for the cost. Many of the special articles are treatises in themselves, and the biographical notices give very satisfactory accounts of the lives and works of musical men of every class, with fullness proportionate, on the average, to the importance of the subject. The purpose of the appendix, which was promised from the beginning of the publication, is to supply omissions and correct errors in the original text, furnish new information, and bring the whole up to the latest practicable dates. It is arranged alphabetically, and forms a considerable volume in itself. A copious index of the whole four volumes will shortly be published in a separate volume.

"Bulletin, No. 36," of the United States National Museum, is *A Review of the Family Delphinidæ*, prepared by *Frederick W. True*, as a contribution to the natural history of the cetaceans. The publication is the forty-seventh of a series of papers intended to illustrate the collections of the National Museum. Previous to preparing the review, Mr. True visited the European museums, in order to examine the type specimens contained in them as an essential prelude to the proper comparison of species. He there also met several zoölogists, who furnished him information; among them, Prof. Flower, who placed in his hands the proof-sheets of his own work on "The Delphinidæ." The present work differs from Prof. Flower's in that it is directed to the determination of

species, while the British author makes the discovery of mutual relations and associations into groups a prominent object.

The tenth volume of the *Resultados del Observatorio Nacional Argentino* at Cordoba, Juan M. Thome, director, contains all the observations made during 1877 for the General Catalogue, the four microscopes, as well as three tallies of transit-threads, having been employed for them; and the zones from 755 to 759 inclusive, with their reduction-tables, and an index for reference. The number of stellar determinations made during the year was 17,380, of which 516 were made in zones. Tables of corrigenda for the present volume, and for the errors detected in the volumes already published, are appended.

The paper of Mr. *Cyrus Thomas*, entitled *Aids to the Study of the Maya Codices* (Government Printing-Office), is based on the assumption that an attempt to decipher those documents on the supposition that they contain true alphabetic characters must end in failure. Some of the characters are more than probably phonetic symbols; but Landa's alphabet furnishes no help in deciphering them, and is evidently based on a misconception of the Maya graphic system. "If the manuscripts are ever deciphered, it must be by long and laborious comparisons and happy guesses." This paper is intended to be a step in that direction. The author concludes that, at the time the codices examined were written, "Maya culture had reached that stage where the idea of phoneticism was being introduced into the writing. Yet it is certain, and even susceptible of demonstration, that a large proportion, perhaps the majority, of the characters are symbols. The more I study these characters the stronger becomes the conviction that they have grown out of a pictographic system similar to that common among the Indians of North America. The first step in advance appears to have been to indicate, by characters, the gesture-sign."

In *Hints for Teachers of Physiology* (D. C. Heath & Co., "Guides for Science Teaching"), Prof. *H. P. Bowditch* makes an attempt to show how a teacher may supplement his text-book instruction by means of simple observations and experiments on living bodies or on organic material, so as to impart to his pupils a knowledge of the foundation on which physiology rests, and bring the impressions made on the senses to aid the memory in retaining the facts communicated didactically. The essay, though simply a primer, is fruitful in suggestions for familiar illustrations.

Though edible mushrooms of many varieties are found in all parts of the United States, few of them are utilized, because the majority of the people do not know how to distinguish them from poisonous species. A useful aid to making this very important distinction is furnished in Dr. *Thomas Taylor's* pamphlet of descriptions, with natural-colored illustrations, of *Twelve Edible Mushrooms of the United States*; which also gives directions for selecting and preparing for the table. The paper is embodied in the report of the Department of Agriculture for 1885, and is published separately by Dr. Taylor in Washington.

Investigations of sorghum-blight and the mildew of the huckleberry, with certain parasitic insects inhabiting the knots produced by it, and the fungous parasites of weeds, together with experiments in the cross-fertilization of corn and the germination of weed-seeds, are described in the *Report of the Botanical Department of the Kansas State Agricultural College Experiment Station.*

A number of documents and papers concerning the care of the insane, and questions concerning the responsibility of the insane, may be noticed in a group. The *Report of the Standing Committee on the Insane* of the New York *State Board of Charities* presents the results of the annual visitation to examine the condition of the eight State hospitals and asylums and the eighteen asylums of the exempted counties. *The Recent Judicial Departure in Insanity Cases*, by *Clark Bell*, reviews two recent decisions of high courts—one of the State of Alabama and the other of the United States—that indicate an approach to a more fixed and accurate definition of the responsibility of the insane than has heretofore prevailed.—In the case of *The Insanity of Oscar Hugo Webber*, Dr. *J. Hendrie Lloyd* enters a protest against the conviction for murder of a man who in the author's view was insane to irresponsibility.—The question of responsi-

bility is brought more directly under view in Dr. *T. R. Buckham's* paper on the "*Right and Wrong*" *Test in Insanity*, in which it is maintained that the subject may be irresponsible, if acting under insane impulses, even if he is aware that the deed he is committing is wrong. — Mr. *A. Wood Renton*, discussing the question of *Testamentary Capacity in Mental Disease*, collates what the courts have defined as the law on that subject, maintains that the issue on that point should be narrowed, when it arises, to the question, "Was this man capable of making this particular will at the time of its execution?"

The Commonwealth is the name of a monthly magazine of 144 pages, published by the *Commonwealth Publishing Company*, Denver, Col., which in June, 1889, had reached its fourth number. Among several stories and miscellaneous articles, we find two or three relating to the early history of Colorado. Of such are "Glimpses of Early Days," describing the site and surroundings of Denver in 1856, before there was a town or house there; a relation of remarkable trials and executions by extemporized courts that took place in the primitive times of "thirty years ago"; and an account of the attempt to set up a Territory of Jefferson in 1859, while the region of Denver was still technically Arapahoe County, Kansas. The effect of a pungent paper, suggesting condemnation of the awkward attitudes into which religious newspapers sometimes place themselves with regard to politics, is neutralized by the editor's depreciation of civil-service reform.

Dr. *T. D. Crothers*, in a paper asking *Should Inebriates be punished by Death for Crime?* and Dr. *Joseph Parrish*, in *The Legal Responsibility of Inebriates*, argue against treating inebriate criminals as if they were responsible, and in favor of subjecting them to the same kind of treatment as is given to the insane.

Six additional numbers of the *Modern Science Essayist*, a monthly publication of lectures and essays on topics immediately related to evolution, invite attention. In the first of the group, No. 7, on "The Descent of Man," Prof. Cope traces the descent in lines not greatly different from those drawn by Prof. Topinard in a recent number of the "Monthly," and insists that man is still subject to the struggle for existence. In "The Evolution of Mind," Dr. R. G. Eccles argues that the elaborate mental functions of man have been gradually developed from the simplest beginnings. In "Evolution of Society," Mr. James A. Skilton treats society as an organism, capable of growth, of decrease as well as increase; of vitality, of disease as well as of health; and of death and decay as well as of life and growth—all by the operation of natural law. In "Evolution of Theology," Mr. Z. Sidney Sampson assumes that the tendency of the general movement of the theistic conception is along the same lines as in scientific thought, from narrower to wider generalization; following the natural order of the evolution of the mind, when free, from lower to higher ideals. In "Evolution of Ethics," Mr. Lewis G. Janes considers the individual as the chief concern, and the individual character as the supreme end, by the perfection of which only society can be perfected. In the twelfth number of the series, the "Proofs of Evolution" are summed up by Mr. Nelson C. Parshall as derivable from astronomy, geology, morphology, embryology, metamorphosis, rudimentary organs, geographical distribution, discovered links, artificial breeding, reversion, and mimicry.

Alphonse Daudet's *La Belle Nivernaise*, or the story of a river barge and its crew, has been selected by Prof. *James Boielle* as the "ideal" reading-book in French for the junior classes of high schools and the higher classes of preparatory schools. Having been written for the author's ten-year-old son, it is commended as a striking example of "a great intellect coming down to the level of a child of tender years, and telling in short, simple, and pithy sentences, pregnant in meaning, the story of the loving sympathy of the poor for their poorer and more defenseless brethren. The notes give clear definitions of idiomatic expressions, with explanations of etymologies and allusions. Ginn & Co.

Three numbers—7, 8, 9—of the seventh series of the Johns Hopkins University Studies in Historical and Political Science are occupied with a paper on *The River Towns*

of Connecticut—Wethersfield, Hartford, and Windsor—by *Charles M. Andrews*. As in the other monographs of this series, the origin, growth, and development of these towns, with the various phases of social, political, and other life which they have passed through, are reviewed from the historical and philosophical point. The agrarian and civil life of the sturdy people who constituted their population, the author observes near the end of his story, "was not essentially different from that existent among the other New England towns; such life was in its general features everywhere the same. On close examination, however, we find that the machinery of town and court administration can be classified as to whether it is pure or mixed, simple or complicated, natural or artificial. To Connecticut belongs the best of these conditions. Her town life was pure, simple, and natural; the law which guided her political relations was nearer to the law which governs to-day than anywhere else on the American continent. We are apt to think of her settlement as an artificial importation, as one ready-made through the influence of pre-existent conditions. Beginning with the commercial stage, when trade was the motive power, it soon entered the agricultural stage, when the adventure lands were occupied by planters. With the development of this phase of its growth the military stage begins, when it became necessary to systematically arm against the Indians, and to turn the agricultural settlements into armed camps, with the people a body of trained soldiers. At this stage the ordinary religious life begins, when systematic church life arises with the infusion of new settlers; and last of all is reached the civil or political stage, when for the first time the settlements may be fairly called organized towns."

The Batrachia of North America, by Prof. *E. D. Cope*, is the forty-fifth of the series of papers illustrating the collections of the United States National Museum. The work embraces the results of a study of the character of the species, with their variations, for which the museum furnished liberal material, and studies of the osteology of the class, based on the material contained in various museums of the United States and Europe. The manuscript prepared several years ago by Prof. Baird and Dr. Girard has also been used, and ninety-one descriptions of species have been taken from it. The results have been expressed largely in systematic form, under the belief that descriptive zoölogy will never be complete until the structure is exhausted in furnishing definitions. Reference is made, wherever practicable, to the relations between the extinct and living forms. The general characters of the Batrachia, their general anatomy, larval characters, classification, affinities, and phylogeny, are considered, and terms and nomenclature explained, in the chapter introductory to the descriptions.

The *Annual Report of the State Geologist of New Jersey* for 1888 announces the completion of the magnetic and topographic surveys. The results have already been published and distributed in the first volume of the final report, recently noticed in the "Monthly." The second volume will contain full catalogues of the minerals, plants, and vertebrate and invertebrate animals, their occurrence and localities and some practical and economic particulars regarding them. The work still to be done in the matter of the geological structure of the rocks of the State consists mainly in combining and systematically arranging the materials which have been collected. A few points remain to be cleared up, and when this is done the volume on structural geology can be prepared, to be followed by one on economical geology. Among the material returns that have accrued to the State from the distribution of the reports are the system of artesian well-boring, which was started at the direct suggestion of the survey; increased attention to the development of the fire and potter's clay properties; drawing attention through the maps to many peculiar advantages of New Jersey; investments induced by the notices of mines, quarries, lime, marls, drained lands, and water supplies; and benefits to agricultural interests. The present report is brief, and includes "Geological Studies of the Triassic or Red Sandstone and Trap Rocks," with papers on drainage of the Pequest meadows and the low lands of the Passaic, water supply and artesian wells, and statistics of iron ores, zinc ores, fire clays, stoneware clays, and bricks.

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POPULAR MISCELLANY.

The Name Silurian in Geology.—We have received from Prof. Dana the following note in explanation of a change in geological nomenclature recently proposed by him:

"The names for the grander divisions of the Palæozoic series below the Devonian used in most of the recently published works on geology are Cambrian, Lower Silurian, and Upper Silurian. Cambrian was proposed by Sedgwick, and Silurian by Murchison, and both names are derived from the names of ancient tribes of Wales. In 1879 Dr. Lapworth proposed to substitute the term Ordovician, a term of like origin, for the Lower Silurian, and its adoption is under discussion. Although not seeing any need of further change, I urged, in my paper before the American Geological Society at Toronto, that the name Silurian, if it is to be restricted, should be used for the *Lower* Silurian rather than the Upper, on the ground that it was more just to Murchison and better for the science. I further added that for a new name for the Upper Silurian, rather than go again to Wales for one, we should consider the claims of Bohemia, the land where Barrande carried forward his great work on the Silurian and associated rocks, or to the region of New York and Canada, made famous geologically by the Palæozoic labors of Hall, Billings, and others. I stated that the French geologist, De Lapparent, had already used the name *Bohemian* for the Upper Silurian; and I then remarked that the lower portion of the Upper Silurian was called the Ontario Division in the Reports of 1842 and 1846 of the New York geologists, Profs. Mather and Emmons, and that this suggested the use of the name *Ontarian*. This would make the names for the three grand divisions referred to the Cambrian, Silurian, and Ontarian.

"JAMES D. DANA."

History in High and Preparatory Schools.—Two opposite demands, according to Mrs. Mary Sheldon Barnes, have to be met in teaching history in the high school; one for the generalities which are the commonplaces of every scholar, the other for fresh and independent study of historic detail from historic sources. As a solution of the difficulty thus raised, the author proposes teaching the general truth through the special fact, and making each pupil judge the special fact for itself in its general aspects. The first step in this direction should be to give the student a little collection of historic data, and extracts from contemporary sources, together with a few questions within his power to answer from these materials. "Then let him go by himself, like Agassiz's famous student with the fish, to see what he can see." The prominent characteristics of the method employed by Prof. I. B. Burgess, of Newport, R. I., for teaching classical history preparatory to college, are, almost exclusive attention to the facts which are essential to the comprehension of Greek and Roman life and its development; the study of primitive facts, such as maps, pictures of Greek and Roman works; speeches and writings of Greeks and Romans; and the use of questions about these facts, which require not the simple repetition of them, but the gathering and comparison of different facts, and the drawing of inferences from them by the pupil himself.

An Unsettled Part of Minnesota.—The report of the Geological and Natural History Survey of Minnesota for 1887 consists most largely of local details, of interest chiefly to the specialist. The work was prosecuted by three parties, two of them operating in the region of the original Huronian and the iron-bearing rocks of northern Michigan and Wisconsin, and the third in the region of Rainy Lake, while briefer surveys were made in other regions. Prof. N. H. Winchell's examination of the original Huronian leads to some important results which have a direct bearing on the classification of the rocks of Minnesota and of the Northwest. Prof. Alexander Winchell describes the Huronian region as traversed from east to west by a low, interrupted swell, called the Giant's Range, and by another series of still higher reliefs called the Mesabi Range—which must, however, be distinguished from another Mesabi Range—but without conspicuous features of mountain relief. As a rule, the surface is rugged and uncultivable. Between Fall Lake and Grand Portage, and north of Grand Marais, the region is "a literal wil-

derness without inhabitant, without mails, without roads, and with only an occasional party of Indians or explorers, following the ancient and overgrown trails of two centuries ago." Fires have denuded the region of its primitive forests; but the older burnings are becoming overgrown with thickets of aspen, white paper birch, cherry, etc. A few remnants of the original forest are occasionally found; and various shrubs and low herbs occur. Many small tracts of deep and productive soil intervene between the almost universal rocky or thinly covered exposures. The summer climate was agreeable, with sunny days as the rule during two seasons. No experience was had of the winter climate. The character of the country covered by Mr. H. V. Winchell's Rainy Lake survey varies greatly in different regions. In the vicinity of Rainy and the neighboring lakes, it is very rocky, while west of these lakes the surface consists of drift deposits, and the underlying rock appears only at rapids and waterfalls in the streams and a few places in the midst of the forest. The region within the limits of the glacial lake Agassiz is now covered with a fine growth of timber, both hard and soft wood, and is excellent farming land.

Old Cyclopædias.—The most extensive, and one of the oldest of cyclopædias is the Chinese work, the name of which may be translated as the "Thesaurus of Writings Ancient and Modern," compiled under the scholarly Emperor Kang Hi, which was printed toward the close of the last century. It was the fruit of forty years of labor, and filled 5,020 volumes; but this by no means implies that it was as large as a European book of that number of volumes would be. Pliny's "Natural History" may be regarded as the oldest European encyclopædia. The "Speculum Majus" of Vincent de Beauvais, in the thirteenth century, was divided into 10,000 chapters, several of which were subdivided alphabetically. About a hundred years later came the "De Proprietatibus Rerum" of the English Franciscan Bartholomew de Glanville, which was translated into the English of the day. Johann Alsted's "Encyclopædia" (1630) was one of the first works that bore the name. The anonymous "Universal Historical Geographical, Chronological, and Classical Dictionary" (1703), a nearly forgotten work, is said to be "full, concise, lively, and, all things considered, wonderfully accurate," but some very funny statements made in it are pointed out. In the next year was published Dr. Harris's "Lexicon Technicum, or an Universal Dictionary of Arts and Sciences," which has been given the credit, that of right belongs to the preceding work, of being the first alphabetical encyclopædia written in English. Next to these works follow the generation of cyclopædias which are still known among us, beginning with Ephraim Chambers's Cyclopædia (1728) and D'Alembert and Diderot's great work, and coming down to the new edition of the "Britannica," Stephen's "Dictionary of National Biography," and Appletons' "American Cyclopædia" and their "Cyclopædia of American Biography."

The Ice-Cap of Greenland.—Dr. Frithiof Nansen showed, in the British Association, in opposition to Nordenskiöld's opinion, that the part of Greenland which his expedition had traversed is covered with a shell-shaped mantle of ice and snow, under which mountains, as well as valleys, have quite disappeared, and where the configuration of the land and mountains can not be traced. The ice covering rises rather regularly but rapidly from the east coast to a height of nine or ten thousand feet, is rather flat and even in the middle, and falls off again regularly toward the west coast. There must be mountains and valleys in the interior of Greenland as well as on the coast. It is already known that there are on the coasts deep fiords and lofty mountains very like those of western Norway, and that they have in some places just the same wild and prominent character. If we entertain the opinion that these fiords were excavated by the ice, we must also conclude that the same ice has been able to excavate valleys and form mountains in the interior of the continent. We have no right, therefore, to seek the reason of the shield-like shape of the ice in the configuration of the land underneath its surface. It must have a shape of its own, which was given, not by the land, but by the meteorological circumstances. Nobody could deny that the ice might in some places have an enormous thickness, as it

filled the valleys and covered up all the mountains. The thickness must be regulated by the quantity of snow falling, and this is largest toward the coast, gradually diminishing toward the interior. Hence the thickness of the ice would be greatest on both sides toward the coast, just as has been observed. The surface of the snow-field in the interior is even and as if polished, resembling the undisturbed surface of a frozen sea, the long but not high billows of which, rolling from east to west, are not easily distinguishable to the eye. The principal factor in giving the surface this shape is the wind. A careful observation of a snow and ice covering like that of Greenland is of great importance for the theory of the formation of valleys and fiords. It seems that the more we study Greenland, its coasts, and its inland ice, the more convinced we must feel of the power of the ice to perform this work.

The Bruce Photographic Telescope.—The Astronomical Observatory of Harvard College has received from Miss C. W. Bruce a gift of fifty thousand dollars for the construction of a photographic telescope such as the director had described in his circular of November 28, 1888, as desirable. The instrument will have an objective of about twenty-four inches aperture, and a focal length of about eleven feet. It will differ from other large telescopes in the construction of its object-glass, which will be a compound lens of the form used by photographers and known as the portrait lens. The focal length of such a lens is very small compared with its diameter, and much fainter stars can be photographed in consequence. The advantage is even greater in photographing nebulæ or other faint surfaces. Moreover, this form of lens will enable each photographic plate to cover an area several times as great as that which is covered by an instrument of the usual form. The time required to photograph the entire sky is reduced in the same proportion. A telescope of the proposed form, having an aperture of eight inches, has been in constant use in Cambridge for the last four years, and is now in Peru photographing the southern stars. It has proved useful for a great variety of researches. Stars have been photographed with it too faint to be visible in the fifteen-inch refractor of the observatory. Its short focal length enables it to photograph as faint stars as any which can be taken with an excellent photographic telescope having an aperture of thirteen inches. The eight-inch telescope will photograph stars about two magnitudes fainter than can be taken with a similar instrument having an aperture of four inches. A corresponding advantage is expected from the increase of the aperture to twenty-four inches. Other advantages to be anticipated from the use of such an instrument will arise from the opportunities which the photographs will give for continuous and detailed study. With them work can be done at any place and any time, and, by multiplying copies, by any number of observers. And with them more could be added by a single lens to our knowledge of the stars than could be obtained by any number of telescopes of the usual kind. Prof. Pickering is seeking the best possible location at which to mount the instrument. Owing to the difficulty in maintaining regular observations in the Eastern States that arise from the prevalence of cloudiness, he suggests one of the mountains of southern California as likely to offer the most favorable climatic conditions attainable.

What it takes to play a Piece of Music.—Science, says Sir James Paget, will supply the natural man with wonders uncounted. The author had once heard Mlle. Janotha play a presto by Mendelssohn. She played 5,595 notes in four minutes and three seconds. Every one of these notes involved certain movements of a finger, at least two, and many of them involved an additional movement laterally as well as those up and down. They also involved repeated movements of the wrists, elbows, and arms, altogether probably not less than one movement for each note. Therefore there were three distinct movements for each note. As there were twenty-four notes per second, and each of these notes involved three distinct musical movements, that amounted to seventy-two movements in each second. Moreover, each of those notes was determined by the will to a chosen place, with a certain force, at a certain time, and with a certain duration. Therefore there were four distinct qualities in each of the seventy-two

movements in each second. Such were the transmissions outward. And all those were conditional on consciousness of the position of each hand and each finger before it was moved, and, while moving it, of the sound and the force of each touch. Therefore there were three conscious sensations for every note. There were seventy-two transmissions per second, one hundred and forty-four to and fro, and those with constant change of quality. And then, added to that, all the time the memory was remembering each note in its due time and place, and was exercised in the comparison of it with others that came before. So that it would be fair to say that there were not less than two hundred transmissions of nerve force to and from the brain outward and inward every second, and during the whole of that time judgment was being exercised as to whether the music was being played better or worse than before, and the mind was conscious of some of the emotions which the music was intended to inspire.

Ancient Chaldean and Modern Measures.—According to Prof. Harkness, in his presidential address to the Philosophical Society of Washington, the ancient Chaldeans used, primarily, the decimal system of notation, and also the duodecimal in the division of the year and of the day into hours, and the sexagesimal in the division of the circle and of the hour and minute. The last two systems were also applied to weights and measures, and impressed upon them by the scientific authority of those ancient sages. "Now observe," says the author, "how the scientific thought of to-day repeats the scientific thought of four thousand years ago. These old Chaldeans took from the human body what they regarded as a suitable unit of length, and for their unit of mass they adopted a cube of water bearing simple relations to their unit of length. Four thousand years later, when these simple relations had been forgotten and impaired, some of the most eminent scientists of the last century again undertook the task of constructing a system of weights and measures. With them the duodecimal and sexagesimal systems were out of favor, while the decimal system was highly fashionable, and for that reason they subdivided their units decimally; but they reverted to the old Chaldean device for obtaining simple relations between their units of length and mass, and to that fact alone the French metric system owes its survival. Every one now knows that the metre is not the ten-millionth part of a quadrant of the earth's meridian, and in mathematical physics, where the numbers are so complicated that they can only be dealt with by the aid of logarithms, and the constant π, an utterly irrational quantity, crops up in almost every integral, mere decimal subdivision of the units counts for very little. But in some departments of science, as, for example, chemistry, a simple relation between the unit of length (which determines volume), the unit of mass, and the unit of specific gravity, is of prime importance; and wherever that is the case the metric system will be used. To engineers such relations are of small moment, and, consequently, among English-speaking engineers, the metric system is making no progress, while, on the other hand, the chemists have eagerly adopted it. As the English yard and pound are the direct descendants of the Chaldean-Babylonian natural cubit and mina, it is not surprising that the yard should be only 0·48 of an inch shorter than the double cubit, and the avoirdupois pound only 665 grains lighter than the Babylonian commercial mina; but, considering the origin of the metric system, it is rather curious that the metre is only 1·97 inches shorter than the Chaldean double royal cubit, and the kilogramme only 102 grains heavier than the Babylonian royal mina. Thus, without much exaggeration, we may regard the present English and French fundamental units of length and mass as representing respectively the commercial and royal units of length and mass of the Chaldeans of four thousand years ago."

Mount Roraima.—Mount Roraima, that sharply perpendicular elevation in Guiana which so long defied attempts to reach its summit, has been ascended twice since it was first conquered by Mr. Im Thurn in 1884—by Mr. F. Dressel and Mr. Cromer, in October and November, 1886. While Mr. Im Thurn's ascent took place at the beginning of the rainy season, Mr. Dressel's was in the dry season, and their respective observations were marked by corresponding differences.

Mr. Im Thurn had observed no animal life while he was upon the mountain; Mr. Dressel saw a few butterflies, all of a dark-brown and nearly black color. In the shallow basins a few specimens of a small black toad with a yellow spot on the throat were found. A third animal form was noticed in the moist earth attached to some plants which had been pulled up—a milliped. The fantastic shapes into which the sandstones have been formed, and the calmness of the scene, affected Mr. Dressel as they had Mr. Im Thurn.

Experience and Training in Mechanical Work.—To be a good mechanic, said Sir Benjamin Browne, at the recent meeting of the British Association, long training is necessary; and, above all, ability to distinguish good work from inferior work. A regular course of progress from one branch to another should be carefully followed, so as to teach every class of work up to the most difficult. In this the real interest of the employer is the same as that of the lad, viz., to learn every step thoroughly, and then pass on to something more difficult. The author contended that a long training in a manufactory is absolutely necessary, and this should be supplemented by theoretical and technical instruction. It would probably be a great gain to give a lad six or eight months of theoretical teaching after he is out of his apprenticeship. The old-fashioned system of apprenticeship, not much shortened, and with very slight modifications, is the only reliable method for either employer or mechanic to learn his business; but, as work has become more scientific and elaborate, it is necessary for any young man who wishes to excel to have a good theoretical and technical training in addition to his factory experience.

How Stone Implements were made.—Mr. Gerard Fowke, of Sidney, Ohio, has been studying the manner in which primitive man made his stone implements. Although the subject is one on which absolute knowledge can never be obtained, he has been able to reach some definite conclusions on it. Some of the material was obtained from extensive quarries in Coshocton County, and between Newark and Zanesville, Ohio, where the hills are seamed for miles with the trenches and pits left by the ancient diggers. To get the flint, the overlying stratum of earth, nine or ten feet thick, had to be removed, with wooden tools. The rock was then cracked by building a fire, and probably pouring water upon it, the process being repeated till the limestone was reached and a hole made large enough to work in. Other cracks were made by building a fire at the lower part of the ledge, and the split rock was detached. This work was sometimes carried on for several hundred yards. The stones were reduced to blocks of suitable size by stone hammers weighing, perhaps, two hundred pounds, and the shaping was carried on with hammers running, according to its stage and the quality of work desired, down to two ounces in weight. The finished object was smoothed and sharpened by rubbing it with sandstones. If a hole was wanted, it was drilled with a stick, cane-stem, piece of bone or horn, flint, or piece of sandstone, which was revolved in the hands, or twisted back and forth with the bowstring. This was not a speedy process. Dr. Rau worked at it experimentally for two years, and left his first hole not bored through. Yet some of the Amazon tribes spend the lifetimes of two men in drilling, with the flexible shoot of a wild plantain and sand and water, the bores of their tubes of rock crystal. Handles were fitted on in a rude way and secured by wrapping with sinew, which shrunk and bound them tightly; or, with the aid of gum. The fashioning of arrow-heads was a very delicate and curious work, requiring skillful manipulation, and was performed with stone hammers or chisel-points of deer-horn or wood.

Bellite.—The new explosive, bellite, was recently subjected in England to some very satisfactory tests of its safety and power. Letting a great weight fall upon cartridges composed of it, they were simply crushed into a hard mass. But when the crushed cartridges were afterward detonated by means of a fulminate, immense energy was developed. Again, when placed in the fire of a smith's forge, it was volatilized. The effect of exploding a three-ounce cartridge on the lid of a case containing bellite was simply to pulverize the wooden case and scatter the

contents. Comparative experiments showed that, when bellite was confined, the energy developed on detonation was equal to that of dynamite; but that when unconfined, bellite apparently did less work. In mine-blasting bellite was proved capable of doing the work of three or four times its weight of gunpowder, without the fumes that rise when dynamite or gunpowder is used.

Distribution of Rotifera.—Of the little animals classified as *Rotifera*, the most species have been found in Great Britain—not certainly because they are more abundant or varied in England than elsewhere, but because they have been more industriously looked for, and more found there. In late years, two and a half times as many species have been added to the British lists as to those of all other countries put together. There are curiosities in the distribution of these animals. Twenty-four out of the recorded species in Australia are also British; and of the remaining species, one has a habitat in the United States. The same phenomena occur, though on a reduced scale, in the United States, Jamaica, and Ceylon. The question arises, How could these minute creatures, which are inhabitants of lakes, ponds, ditches, and sea-shore pools, contrive to spread themselves over the whole earth? A species which is known only in a small duck-pond in England has also been found at Sydney. Another species has been found almost simultaneously at Sydney and in Ontario. These creatures, "to whom a yard of sea-water is as impassable a barrier as a thousand miles of ocean," could only have reached distant countries in the egg; this they do by the hardy ephippial egg. These eggs fall to the bottom of the water in shallow pools, or are attached to the confervoid growth on the stones. The pool dries up, is swept by the winds, and the eggs are lifted up and carried away. There is hardly any limit to the distances to which they may be thus taken and yet keep vital. Then, as Dr. C. T. Hudson shows in his paper on this subject, "the eggs, of course, must often fall on unsuitable places, and be carried past suitable ones, and this accounts for the capricious appearance of *Rotifera* in some well-watched ponds, and for the frequent disappointment of the naturalists who visit such spots. To this aërial carriage of the eggs is also due the perplexing fact that when any rare *Rotifera* is found in one spot, it is frequently found at the same time in closely neighboring ponds and ditches, even in such an unlikely hole as the print of a cow's foot filled with rain, but not at all in more promising place, at some distance off." They may also be distributed by water-birds and dogs. The animals themselves are very hardy against heat and dryness. The *Philodinadæ*, when time is given them to don their protective coats, can bear a heat gradually advancing to 200° Fahr., or a fifty days' exposure to a dryness produced over sulphuric acid in the receiver of an air-pump.

The City of the Cat-Goddess.—M. Edouard Naville recently gave before the Victoria Institute an account of his important discoveries at Bubastis, one of the ancient great cities of the Delta of Egypt, and the principal seat of the worship of the cat-goddess, Pasht. The speaker said, at the beginning of his lecture, that it was remarkable that while one of the latest writers on the East had referred to the failure of the prophecies of Ezekiel regarding the cities of Egypt, he had himself found in the same prophecies the light by which he was guided in his search. Bubastis was found to have been a city of much more historical importance than had generally been supposed, the recovered monuments bearing dates all the way down from the fourth (or Pyramid-builders') to the thirtieth, or last Egyptian, dynasty. The most conspicuous relics were of the fourth, sixth, twelfth, shepherds', nineteenth, and twenty-second dynasties. Some very interesting relics of the shepherd-kings, hitherto rare except at Tanis, were found; and from the beauty of their statues, and other evidences, the author concludes that they must have been a highly cultivated people, and have come probably from Mesopotamia. Dr. Virchow considered that their monuments represented Turanians, and Prof. Flower that they represented people of a Turanian or Mongolian type. But that did not mean that the population itself was Turanian. Their worship and language were of a Shemitic type, but the statues of their kings showed that they were not Shemites. M. Naville remarked: "It was then what it still

is now; and I believe that the conquest of Egypt by the Hyksos is not unlike what would happen at the present day if the population of Mesopotamia overran the valley of the Nile: you would have masses, in great majority of Shemitic race, speaking a Shemitic language, and having a Shemitic religion, but under the command of Turks, who are not Shemites, but Turanians." M. Naville regards the successive discoveries that have been made in the Delta as making the Bible-story more comprehensible in some points, and as showing that the distances were much shorter than was generally thought. "I consider it important, for instance, to have established that Bubastis was a very large city, and a favorite resort of the king and his family. It is quite possible that, at the time when the events preceding the Exodus took place, the king was at Bubastis, and not at Tanis, as has been generally believed."

Composition of London Fogs.—Studies of London fogs by various observers show that during the winter the air of the metropolis has an unusually large amount of carbonic acid in it. Thus, Dr. W. J. Russell found on one day, a few years ago, that it contained more than three and a half times the average amount. This is derived, to a large extent, from respiration, and more from coal-burning; and "it is almost indisputable that the latter produces the well-known black fogs and yellow fogs." The relative thickness and density of the air of different parts of London have been investigated by Mr. W. H. Raffles, who took a station on Primrose Hill and observed the visibility, on different days, of prominent objects at known distances in different directions. These observations showed plainly that the amount of fog was largely governed by the density of the population and the frequency of factories. A similar conclusion is drawn from the number of hours in the daytime on which artificial light was used. Homerton had twice as many hours of darkness as any other district represented in the tables, and it has a very large number of factories in its neighborhood. Of other towns in which the inquiry was pursued, Leeds suffered most from darkness, probably for the same reason; while Manchester is said to have been unusually free of late years from dark fogs, probably because many mills have moved out. The ordinary white fog has also been reduced by the draining of morass lands near the city. A conception of the cost of London fogs may be gained from the fact that during nine days of fog in November, 1887, the public paid a single one of the several companies four hundred and ninety pounds, or twenty-four hundred and fifty dollars, an hour for artificial light.

Geological History of Yellowstone Park.—The geological history of Yellowstone National Park has been traced by Mr. Arnold Hague in an address before the American Institute of Mining Engineers. Throughout Tertiary time the history was characterized by great volcanic activity. Within very recent times there is no evidence of any considerable outburst; indeed, the region may be considered long since extinct. The volcanic rocks present a wide range in chemical and mineral composition and physical structure, but may all be classed in the groups, following one another in the order named—andesites, rhyolites, and basalts. Since the close of the Ice period no geological events of any moment have brought about any changes in the physical history of the region other than those produced by the direct action of steam and thermal waters. Indications of fresh lava-flows within historical times are wholly wanting. All our observations point in one direction, and lead to the theory that the cause of the high temperature of the waters of the geysers and hot springs must be found in the rocks below, and that the origin of the heat is in some way associated with the source of volcanic agency. But it does not follow that the waters themselves are derived from any deep-seated source; on the contrary, investigation tends to show that the waters brought up by the springs are mainly surface-waters which have percolated downward a sufficient distance to be heated by large volumes of steam ascending through fissures and vents from much greater depths. The existence of such currents of steam and hot water is attested by the decompositions they have effected upon the rocks, which "have proceeded on a most gigantic scale"; and they have left an indelible impression upon the surface of the country. The study

of the age of the present geysers by observation of the rate of deposit of sinter indicates a great antiquity for them—over twenty-five thousand years for "Old Faithful." Our accurate knowledge of them only began in 1871. The number of geysers, hot springs, mud-pots, and paint-pots scattered over the park exceeds thirty-five hundred, and the addition of the fumaroles and solfataras would make the whole number of actual vents double that.

Mound-Builders and Indians.—"Some Popular Errors in regard to Mound-Builders and Indians" are reviewed by Mr. Gerard Fowke, in the "Ohio Archæological and Historical Quarterly." The high civilization ascribed to the mound-builders is denied, because they have left no evidence that they could use stone-dressing tools, could carry earth only in baskets or skins, and have left no indications of having possessed a written language or domestic animals, etc. Against the assumption that they possessed a great population, it is shown that while the construction of all their works in Ohio did not require an amount of labor equal to that used in the excavation of certain modern works, there is nothing in the way of their having had an indefinite time in which to perform it. While "there is sufficient accuracy in some cases to make one wonder that the builders could have done as well as they did, no evidence appears of any 'calculaation' beyond the mere sighting and measuring possible to any one." The supposed evidences of the great antiquity of the mounds and of the extensive commerce of the builders are assumed to be insufficient or fallacious; minor errors, concerning the distance from which the earth used in building the mounds had to be brought, concerning the size of the builders, the soundness and other peculiarities of their teeth, and the supposed artistic excellence of their work, are corrected; and the questions whether there is anything in their work that the Indians could not have executed, and whether the Indians had knowledge of them, are taken up. Traditions exist among the Indians of Michigan and Wisconsin of tribes who built mounds, and of definite occasions when mounds were built. A certain tribe were called by the Sioux Ground-House Indians, because they lived in houses covered with earth. The chronicles of De Soto's expedition describe the houses of the Cherokees as being built upon mounds, and the French give a similar description of the house of the king of the Natchez. Certain earthworks in western New York, Ohio, and Pennsylvania are conceded to have been built by the Iroquois and adjacent tribes. The Indians of the Ohio Valley may have been ignorant of the subject, because they were a comparatively recent arrival. It is objected that the Indians could not have built the mounds, because the builders must have been a settled and agricultural people, while the Indians live by hunting and fishing. But it is a historical fact that, before they were disturbed by the whites, the Indians also were agriculturists, raised good crops, and stored their grain, so that they were able to supply the expeditions that came among them. We can not judge of what they were from what they are, after having been ruined by their contests with the whites and their vices. The race that produced a Logan, a Corn Planter, a Red Jacket, a Tecumseh, and other men of like genius, might also have developed men competent to construct all the works that now puzzle us. Some of Mr. Fowke's assertions are traversed and shown to be erroneous in the "American Antiquarian," which, while it admits that the Indians built mounds, holds that there were other and more extensive mound-builders before them.

Experiments in Germination.—A series of testings of the influences of certain conditions on the sprouting of seeds, described in a bulletin of the experiment station at Cornell University, indicates that variations of temperature are an important factor in the matter, and that a constant temperature gives quicker results than an ordinarily variable one of which that is the mean. The mean employed in most of the experiments was 74°; but there is probably a tolerably well-defined best temperature for each species of plant, the limit of which is not closely determined for most garden seeds. Soaking the seeds does not appear to influence the total amount of sprouting; nor does it seem to hasten the sprouting, if the planting-time is reckoned from the moment of putting

the seeds to soak; it only shortens the time the seeds have afterward to remain in the soil. The character of the soil may influence the results. Light, when it has any influence—and it has great influence with some species—has a retarding effect. The weight of the seed is often a tolerably accurate measure of its viability. As a rule, heavy seeds germinate better than light ones of the same sample. When variability was perceived with reference to color, the stronger sproutings usually occurred in the darker-colored seeds. The latitude in which seeds are grown may determine their behavior in germination—northern-grown seeds seeming to germinate more quickly than southern-grown. More than one test is needed to be decisive respecting any sample of seeds. There appear, from the testings reported, to be no pernicious adulteration of garden seeds in this country, and no hurtful impurities.

Tapioca.—The *manihot*, or tapioca plant, was originally a native of tropical South America, but is now largely cultivated throughout all tropical countries. It is a small, shrubby plant, growing from four to eight feet high; and becomes suitable for use in from sixteen to eighteen months after the young plants are established. Besides the well-known wholesome food, the root abounds in a peculiar poisonous juice, which is said to be analogous to hydrocyanic acid; but this substance being volatile and easily destroyed by fermentation, no difficulty is met in procuring the food-product free from it. The pulp obtained from the roots is washed in cold water, after which, upon resting, the starch subsides. The water is then drawn off and the starch is heated, when pearl tapioca is obtained. In preparing the cassava meal, the roots having been prepared, are baked on an iron plate. Thus prepared, the meal swells considerably in water or broth, and is called *cerraque*. If, instead of drying the grated pulp, it is spread upon a hot iron plate, the starch and mucilage, by mixing together, consolidate the pulp and form a biscuit, called cassava bread, which is a very important and nutritious food. The resultant of the mastication of these cakes, upon fermentation, produces an agreeable but intoxicating drink.

The Island of Paros and its Marbles.—The Island of Paros, according to Mr. R. Swan's description in the British Association, is eleven miles long and eight miles broad at its widest part, with a mountainous interior rising to a height of twenty-five hundred and thirty feet, and a broad belt of nearly level land round the coast. The southern part of the island consists chiefly of crystalline limestone, of undefined age but probably Cretaceous. The finest statuary marble, or lychnitis, varies from five to fifteen feet in thickness at the quarries of St. Minas, and occurs in a bed of coarse-grained white marble with bluish-black veins. The coarse marble becomes dark in color near the lychnitis, both above and below it, and thus the layer of statuary marble is distinctly marked off. The dark color is due to traces of binoxide of manganese and magnetic oxide of iron. The rocks are much disturbed and folded, and often dip at high angles. The ancients avoided the marble lying near the axis of elevation, which was of inferior quality to the other parts. A Greek company, formed a few years ago to work the quarries, attacked the rock here, where it could be got at least expense, and so discredited the marble in the market that it went down, after one hundred and sixty thousand pounds had been spent in getting the quarry ready. There is a good deal of excellent colored marble on the island, but, not having been used by the ancient Greeks, is not much known.

A Classification of Incendiaries.—Dr. J. A. Fowler, of Philadelphia, has made a classification of more than twenty different kinds of incendiaries, or motives to incendiarism. They are—1, the incendiary policy-holder; 2, the incendiary for gain or advantage other than insurance; 3, the revengeful incendiary; 4, the discharged hand; 5, the malicious servant; 6, the rioter; 7, the tramp; 8, the thief (for concealment of theft); 9, the thief (for opportunity for theft); 10, the murderer (for concealment of crime); 11, the incendiary for murder; 12, the mischievous small boy (or girl); 13, the contriver for incendiary reward; 14, the fire-bug, or fire conspirator (terrorizing by fire); 15, incendiarism from momentary rage; 16, the drunken incendiary; 17, in-

cendiary firemen; 18, the don't-care bonfire-kindler; 19, the don't-care pyrotechnic exploder; 20, the don't-care manufacturer of unsafe kerosene, etc.; 21, the "pyromaniac." The last four can not be considered legal incendiaries, "but they bring the trespass so near the crime that they can be admitted into the insurance catalogue of incendiaries as practically such."

The Condition of Deep-Sea Life.—It is suggested by Mr. A. R. Hunt, in "Nature," that the depth of the horizon above which deep-sea fish do not rise, is controlled rather by the matter of wave-motion than of the penetration of light. It is doubtful if sunlight ever penetrates to the depth of a hundred fathoms, which Günther has indicated as marking the beginning of deep-sea life; but that depth has been indicated by Mr. Hunt as the extreme depth to which wave-action reaches. This view is fortified by the fact that, though the deep-sea forms do not usually ascend above the hundred-fathom line, the shallow-water forms go far below it; and there is no reason why they should not do so; for, although a form unfitted to withstand wave-currents can not face them, there is nothing to prevent a flat fish, fully equipped as to this condition, from passing at will from the disturbed to the tranquil horizon, and returning.

The History of the Doctrine of Assassination.—The history of the doctrine of political assassination or tyrannicide has been elucidated by a writer in the "Edinburgh Review." It prevailed among the ancients, as is illustrated in the stories of Brutus and of Harmodius and Aristogiton. Its great apologists have been the Jesuits, but it is much older in its Christian form than the Jesuit order. At the beginning of the fifteenth century, not to go further back, a Franciscan friar, Jean Petit, who was Professor of Theology at Paris, undertook to justify the murder of the Duke of Orleans, on the plea that "it is lawful, by natural and divine law, for every subject to kill or cause to be killed a traitorous and disloyal tyrant." His teaching was denounced by Gerson and condemned by the Council of Constance. The decree of the council was, however, rejected by one author because it was not sanctioned by the Pope; while others sought to evade its force by making a distinction between a tyrant *in titulo*, or a usurper, and a tyrant *in regimine*, who is a lawful sovereign but has abused his trust. The decree could not, these writers alleged, apply to the tyrant *in titulo*, because a usurper has no subjects. Mariana, in his famous work "De Rege et Regis Institutione," published in 1599, defined as tyrants all sovereigns, legitimate or not, who forfeit their rights by governing for their own selfish interests, not for the good of their people; and held that such unjust rulers became the enemies of the human race, and might lawfully be slain by their subjects. He argued that the sovereign power is always dependent on popular consent, and that a tyrant is worse than a ferocious wild beast. When there existed a public assembly in the country, it should meet and pronounce sentence first, but, where no such resource was available, any person who had the courage might lawfully make himself the interpreter of the popular will. But the use of poison was forbidden by the common sense of mankind. The doctrine is, however, a most mischievous one, which is easily made to work both ways.

Evolution and Disease.—Dr. R. G. Eccles, in a paper on "Heredity and Disease," advises the application of the principles of evolution to pathological studies. "A vague, uncritical sort of belief in the transmission of disease tendencies," he says, "has obtained among general practitioners for a long time. Few have dared to allow themselves to speculate upon the possibility of this chain of tendencies stretching back into the world of animated nature below us. No one has a due conception of the vast magnitude of the possibilities involved in so daring a speculation. Is there any reason for believing that a large number of weaknesses and disease tendencies of the human family are part of this great system that makes us appear as if we had descended from quadrupeds? What harm can it do for us to work on this assumption for a while, and see whether or not it will prove as fruitful to the pathologist as it has been to the botanist, zoölogist, and physiologist?" In a similar vein Dr. Wesley Mills regards the various forms of disease as so many cases,

by the deterioration of his higher faculties, of reversion toward the lower forms from which man is derived. Thus, the dying human subject sinks functionally lower and lower in the scale of animal life. In sleep it will be seen, if we consider the nervous system, that the parts peculiar to man, or most developed in man, are the ones that for the time being are as good as annihilated. Similar tendencies toward a sinking to equality with lower forms may be observed in hypnotism, somnambulism, and allied phenomena. It is seen, on a lower level, in hibernation, when certain normally very active animals return to a condition like that present in cold-blooded animals. In paralysis, the graver the affliction the lower in the scale must we seek to find an animal comparable to man in that condition. Views in harmony with those of Prof. Mills were published by Dr. Milner Fothergill.

The Office of Iron in the Blood.—Iron exists in the blood in the red corpuscles, and gives them color and the power of absorbing gases. The fact that peroxide of iron is one of the readiest absorbents of gases, and parts with them as readily on exposure in thin layers to the air, so that it can be used over and over again for that work, gives a clew to its special function in the red corpuscles of the blood. It enables them readily to absorb oxygen as they pass along the minute blood-vessels of the lungs, and to carry it to all parts of the body, where they part with it as it is demanded. It is supposed, also, to take up carbonic acid in exchange for the oxygen it yields up, and to convey to the lungs that portion of this substance which is expired. If this be its double function, it is one the importance of which can hardly be exaggerated; for it is, in effect, to be the vehicle to all parts of the organism of that which makes them vital, while it also removes the waste of their life, which would otherwise clog their activity. The chemical changes in the life of plants are effected by means of the iron which is contained in the chlorophyl by processes that differ in particulars, but are dependent on the same absorption principle of the peroxide. Thus "it is an interesting coincidence that iron should be the active agent in both animal and vegetable life for the assimilation of the air substances required for their existence; and that at the same time it should be intimately connected with the production of the distinctive color of the blood and of the foliage of plants."

Iron Railway-Ties.—Iron sleepers or cross-ties have been in use for many years on the railroads of India, and have proved as free from liability to accident as wooden ties. The East India Railroad has more than one thousand miles laid with them, and is adding to the length every year. It runs the fastest and heaviest trains on the peninsula, and has enjoyed an almost proverbial immunity from accidents. The "bowl sleeper" appears to be the standard type, although it was once condemned. It lies more steadily and is less liable to horizontal displacement than any wooden sleeper. It, however, makes the track too rigid, and is not suitable for high speed, and is likely to be discontinued again. A tie called the "D and O sleeper" gives a more elastic track, and is more conveniently packed than the hollow sleepers.

NOTES.

THE Board of Directors of the Zoölogical Society of Philadelphia asserts in its last report that the collection has at no previous time been so well able to fill its part among the educational institutions of the city as at present. It contains a sufficient variety of specimens to give a comprehensive idea of the four classes of vertebrates. Some of the larger groups are exceptionally well represented. The series of monkeys is large, and contains a number of species rarely seen in captivity, as well as six specimens of lemurs. The collection of parrots is also worthy of special attention. Arrangements have been made for securing an extensive collection of North American forms of reptiles and amphibians.

A REVIEW of "The Sociological Position of Protection and Free Trade" leads Mr. Lester F. Ward to the conclusion that "free trade, *laissez-faire*, and individualism in general, represent the untamed forces of nature, such as would exist in the physical world had there never been any inventions, contrivances, machinery, or arts"; while "protection belongs to the great class of ingenious instrumentalities which the civilized brain of man has learned to devise and employ for the regulation, control, and utilization of natural agencies."

THE studies of Sir J. William Dawson on the Eozoic and Palæozoic rocks of the Atlantic coast of Canada have led him to a conclusion that, in the rocks from the Lawrentian to the Trias, a continuous parallelism exists on the two sides of the Atlantic, in mineral character and order of succession of aqueous deposits; in the occurrence of great earth-movements of elevation, depression, and plication, at corresponding times; in the ejection of like kinds of igneous rocks in connection with like members of the aqueous series; in the order of introduction and extinction of animals and plants; and in the specific identity of animals and plants in corresponding formations.

PROF. WILLIAMSON has reported, in the British Association, concerning some specimens of the fruiting of the *Calamites* of the coal-measures, which he regarded as demonstrating his opinion that these plants were equisetiform cryptogams.

THE experiment of amalgamating the Indians with the surrounding population in Canada and inducing them to adopt a settled life has been most successful in Ontario, and in all cases the tribes show an increase in numbers. There are 124,589 Indians in the Dominion, of whom 37,944 are in British Columbia; 26,368 in Manitoba and the Northwestern Territory, 17,700 in Ontario, 12,465 in Quebec, 8,000 in Athabasca, 7,000 in the Mackenzie district, 4,016 in Eastern Rupert's Land, 4,000 on the arctic coasts, 2,145 in Nova Scotia, 20,338 in the Peace River district, 1,594 in New Brunswick, 1,000 in the interior of Labrador, and 319 in Prince Edward Island. The Indian schools are attended by 6,127 youth and girls, one half of them being in Manitoba and the Northwestern Territory.

EXPERIMENTS by Mr. J. B. Francis, of the American Society of Civil Engineers, show that under a pressure of seventy-seven pounds per square inch, more than seventeen gallons of water per square foot of surface will pass through sixteen inches of cement in twenty-four hours. Thick brickwork laid in cement permitted a copious percolation of water under pressure.

"LA NATURE" has a commendatory notice of the display of American precious stones that has been arranged by Mr. George F. Kunz, of this city. It includes splendid specimens of native crystallized gold from California; diamonds; "incomparable" rubies, including one quite exceptional in color and limpidity, from Franklin, N. C.; sapphires of rare quality, emeralds, tourmalines, perfectly clear rock crystals, periodotites; amethysts of a deep, transparent violet; obsidian, gadolinite, and turquoises; also specimens of Indian jewelry-work, in which turquoises are used; "superb" specimens of pyrites, azurite, malachite, and amber are also mentioned.

DR. ALFREDO DA LUY, of Rio Janeiro, believes that the climate of Brazil is degenerating to Europeans, especially to persons from the north. He has noticed that Brazilians in general are more pallid, and are less vigorous and energetic, than persons coming from temperate and cold climates. The degeneration of the Portuguese race may also be noted in Rio de Janeiro. An anæmic condition, caused by malarious influences, is common among them, and, while it does not kill by itself, weakens the hold on life and greatly increases the infant mortality. The children of Portuguese and Italians do not seem to fare so badly as the children of parents coming from more northern countries.

ACCORDING to Dr. Macgowan, it is believed in India, China, and Indo-China that a cobra that escapes an attack from a man will eventually revenge itself upon its assailant, whatever he may do or wherever he may go. The Chinese believe, too, that the killer of a cobra will be haunted afterward by its spirit, hence the snakes are shunned rather than attacked. Among the stories by which this superstition is enforced, is one of a snake-spirit which, entering into possession of the slayer of the reptile, used its voice to curse him until he was relieved by death. Stories are also given of the gratitude of snakes. The recently established native newspapers of China are full of accounts of popular superstitions, prodigies, tales, monstrosities, etc., illustrating the folk-lore of the country.

"THE LANCET" observes that it has been frequently remarked that genius and insanity are sometimes combined in the same person or in closely connected members of the same family; but it is not easy to trace the connection between those mental conditions and the sinful or criminal acts that are apt to be committed by persons so organized. The medical profession recognizes forms of affection or moral insanity in which the capacity to govern the emotions is in abeyance. A marked feature of this phase of mental disease is the absence of delusions; and from that fact conflict often arises between the medical and legal aspects when the question of criminality has to be taken into consideration.

PROF. STEENSTRUP has given an account, to the Scientific Society of Copenhagen, of the results of his examination of a great mammoth deposit at Predmost, in Moravia. Dr. Wankel and Prof. Maschka believe that the animals were killed by man and brought to the district to be eaten. Prof. Steenstrup believes that they came to the place of themselves, and died from some cause with which man had nothing to do. But, in maintaining his position, he has to account for some of the bones being split, for their bearing marks of fire, and for decorative lines having been scratched upon them.

DISCUSSING the relation of occupations and trades to public health, Dr. John T. Alridge remarks that erroneous conclusions may be drawn by overlooking factors which, though potent, are not prominent to view. Thus, as a general rule, light occupations, in good social credit, will attract a large ratio of weak lives, pronounced incapable of active labor. Such an occupation is that of clerk; and we must not lay too much stress on its unhealthfulness as being a sedentary calling, when, in truth, it is largely filled with persons already of sickly habit. Dr. Alridge believes that inhalation of dust is a most effective cause of disease, and that those occupations in which much dust is stirred are intrinsically the most unhealthy.

IN providing for the water-supply and the disposal of the sewage of the city of Toronto, engineers have to deal with the problem which is presented by the necessity of drawing the water from and returning the sewage to the same body—Lake Ontario. The water intake is now through a crib fixed at about two thousand feet from the outer shore of the island that lies in front of the harbor. Messrs. Rudolp Hering and Samuel W. Gray, who were invited to study the subject and report upon it, have reached the conclusion that "for many years to come no objection can arise and no pollution will be observed, if the sewage outfall is placed as proposed, six and one half miles from the present water intake."

THE British Association Committee on the circulation of the underground waters of the kingdom, etc., reports that since it was appointed, fourteen years ago, the recognition of those stores as affording efficient supplies of water free from organic impurity at relatively little cost has made great progress. The publication of the results already obtained has been greatly appreciated by engineers and contractors, and has helped and supported recommendations of water-supplies from underground sources. As time goes on, large numbers of borings are annually made; and numerous provincial societies are giving attention to the subject and publishing results.

MR. J. A. LOUDON, of Newcastle, showed in the British Association that peat fiber can furnish a suitable material for the manufacture of brown paper, wrappers, and millboards. It is not, however, available for white paper.

A METHOD of making bottles by machinery was described by Mr. H. M. Ashley in the British Association. The resultant bottle is homogeneous, with ring, neck, body, and bottom, all as one. Specimens had been subjected to an internal pressure of three hundred poundst to the square inch without any being broken. The use of the method is expected to do away with the most unhealthy part of the ordinary process of blowing bottles.

OBITUARY NOTES.

MR. C. SPENCE BATE, a British authority on crustaceans, has recently died at Plymouth. He was the author of a report on a class of crustaceans collected by the Challenger Expedition; of a catalogue of certain crustaceans in the British Museum; of a "History of British Sessile-eyed Crustaceans"; and of a work on the "Pathology of Dental Caries."

PROF. GEORGE H. COOK, of Rutgers College, and State Geologist of New Jersey, died at New Brunswick, in that State, September 22d, in the seventy-third year of his age. He was born at Hanover, N. J.; became a civil engineer in 1836; laid out the line of the Catskill and Canajoharie Railroad; was graduated from Troy Polytechnic Institute in 1839; was made senior professor in that institution in 1840; became Professor of Mathematics and Natural Philosophy in Albany Academy in 1842; Principal of the Academy in 1858; Professor of Chemistry and Natural Philosophy in Rutgers College in 1852; Assistant Geologist of New Jersey in the next year, and State Geologist in 1864, when he was also made Vice-President of the State Scientific College. He was actively connected with the State Board of Agriculture; became Director of the State Weather Service; visited Europe three times on scientific errands; and was associated with many public enterprises.

PROF. LEO LESQUEREUX, the eminent botanist and paleontologist, died at Columbus, Ohio, October 25th, in the eighty-fourth year of his age. He was a native of Switzerland, was a friend of Guyot and Agassiz, and came to the United States in 1848. He was the author of nearly fifty scientific works; and in his special field of study he ranked with Oswald Heer. A sketch of his life and works, accompanied by a portrait and a list of his writings, was published in "The Popular Science Monthly" for April, 1887.

DR. JAMES PRESCOTT JOULE, F. R. S., the discoverer of the mechanical equivalent of heat, died at Sale, near Manchester, England, October 11th. He was the son of a brewer in Salford, and was born in 1818. His first contribution to scientific literature was made when he was about twenty years old, in a paper describing an electro-magnetic engine. His great discovery was made after patient, independent investigation and experiment, with extremely simple apparatus constructed by himself. He constructed electro-magnets of greater carrying power than any previously known; devised electro-magnetic engines and new forms of galvanometers; measured the heat evolved by the passage of electricity through mechanical conductors; and determined the ratio between chemical and thermal energy. A sketch of his life and a portrait were given in "The Popular Science Monthly" for May, 1874.

ALEXANDER WILSON.